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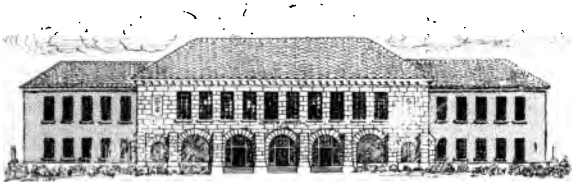

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DUBBS' COMPLETE MENTAL ARITHMETIC

◆

A VOLUME OF CAREFULLY GRADED EXERCISES
ADAPTED TO THE USE OF ALL SCHOOLS

CINCINNATI
E. L. DUBBS & CO., PUBLISHERS
551 WEST FIFTH ST.
1893

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"DUBBS' ARITHMETICAL PROBLEMS."

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PREFACE.

OF all the branches now taught in our schools, Mental Arithmetic is perhaps the most important, inasmuch as it develops and strengthens the reasoning faculties more rapidly and thoroughly than the study of any other branch, while at the same time it insures the exact use of language. And as a knowledge of arithmetic is the basis of all future attainment in mathematical studies, it is evident that the instruction given upon this subject should be exhaustive and complete, and the student made master of every detail throughout all of its various departments.

The art of reasoning from known to unknown—from part to whole, and *vice versa*—is not only useful, but attractive; and the learner, when once fairly upon the highway of rational method to a valuable end, will readily pass from one success to another—finding pleasurable recreation rather than mystery and difficulty in his endeavors to attain higher proficiency in the mathematics beyond.

Education has become a matter of paramount importance, and the venerable pastime of "doing sums" without a *why* for rule, or a *reason* for explanation—or, in analysis,—"darkening counsel by words without knowledge" to the confusion of mind and abuse of language; —all this is rapidly giving place to improved text-books, fresher subject-matter, and approved methods of analysis and proof. Within the last two decades great improvements have been made in many departments; and with the hopeful expectation that a higher degree of perfection may be attained, the author of this little work—induced by the request of educational friends, and encouraged by the successes of twenty years' experience—makes this contribution to the list of Mental Arithmetics, already seemingly great enough.

And in preparing what is now offered to teachers and students, he rests his claim for public favor upon the freshness of subject-matter herein contained, more rational methods of analysis, a greater number of classified problems, and, throughout the work, a golden mean between the comparatively *easy*, and the extremely *difficult* —avoiding thereby a waste of time upon that which is *valueless*, because *puerile*, or *hurtful*, because *exasperating* —a profligacy in time and language without commensurate compensation.

On the use of *signs*, an attempt is made toward greater simplicity and severer accuracy; and just here opinions adverse to the author's may arise—perhaps objection be made to the seeming encroachment upon the domain of Algebra. But the time is coming (and the advance may as well begin *now*) when *characters* for the unknown, and arithmetical equations for the expression of arithmetical thought are entirely proper in many departments of Mental Arithmetic. The mind *thinks* by *ideas*, and the mouth *speaks* by *words;* and whether the object of perception be an idea, or a group of ideas unified, and whether the language of analysis be oral or written, our mental moods and motions are more correctly represented by arithmetical equations containing signs and characters than by verbose rigmarole, and the mind proceeds just as logically when perception rests upon a *letter*, as when upon an *entity* called *unity* or *thing*.

By this use of equations (or arithmetical sentences) several solutions by as many different pupils may be accomplished in the same time formerly consumed by one pupil in the wordy analysis; and it is claimed for this procedure that the plainest and briefest expression for mental operations *saves valuable* time, and is most likely to be *nearest to the actual logic of the mind itself.* By the old-time analysis the words spoken or printed in the solution of many problems would occupy half a page of the book, or consume several minutes in utterance.

With these prefatory remarks, the author offers this volume as a companion to his book of "Arithmetical Problems," trusting that his labors may receive that candor in criticism and fairness in trial which every conscientious professional would crave for himself.

EUGENE L. DUBBS.

Cincinnati, *Ohio*, *August* 26, 1893.

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Complete Mental Arithmetic

Section I.

ADDITION.

LESSON I.

ADDITION is the process of finding the sum of two or more numbers.

The *sign* of addition is +, and it is called *plus*, which means *more*. It shows that the numbers between which it is placed are to be added. The sign of equality is =. It is read *equals*, or *is equal to*, and shows that the numbers between which it is placed are *equal*. Thus, 1+2=3.

ADDITION TABLE.

1+ 1= 2	2+ 1= 3	3+ 1= 4	4+ 1= 5
1+ 2= 3	2+ 2= 4	3+ 2= 5	4+ 2= 6
1+ 3= 4	2+ 3= 5	3+ 3= 6	4+ 3= 7
1+ 4= 5	2+ 4= 6	3+ 4= 7	4+ 4= 8
1+ 5= 6	2+ 5= 7	3+ 5= 8	4+ 5= 9
1+ 6= 7	2+ 6= 8	3+ 6= 9	4+ 6=10
1+ 7= 8	2+ 7= 9	3+ 7=10	4+ 7=11
1+ 8= 9	2+ 8=10	3+ 8=11	4+ 8=12
1+ 9=10	2+ 9=11	3+ 9=12	4+ 9=13
1+10=11	2+10=12	3+10=13	4+10=14
1+11=12	2+11=13	3+11=14	4+11=15
1+12=13	2+12=14	3+12=15	4+12=16

$5+1=6$
$5+2=7$
$5+3=8$
$5+4=9$
$5+5=10$
$5+6=11$
$5+7=12$
$5+8=13$
$5+9=14$
$5+10=15$
$5+11=16$
$5+12=17$

$6+1=7$
$6+2=8$
$6+3=9$
$6+4=10$
$6+5=11$
$6+6=12$
$6+7=13$
$6+8=14$
$6+9=15$
$6+10=16$
$6+11=17$
$6+12=18$

$7+1=8$
$7+2=9$
$7+3=10$
$7+4=11$
$7+5=12$
$7+6=13$
$7+7=14$
$7+8=15$
$7+9=16$
$7+10=17$
$7+11=18$
$7+12=19$

$8+1=9$
$8+2=10$
$8+3=11$
$8+4=12$
$8+5=13$
$8+6=14$
$8+7=15$
$8+8=16$
$8+9=17$
$8+10=18$
$8+11=19$
$8+12=20$

$9+1=10$
$9+2=11$
$9+3=12$
$9+4=13$
$9+5=14$
$9+6=15$
$9+7=16$
$9+8=17$
$9+9=18$
$9+10=19$
$9+11=20$
$9+12=21$

$10+1=11$
$10+2=12$
$10+3=13$
$10+4=14$
$10+5=15$
$10+6=16$
$10+7=17$
$10+8=18$
$10+9=19$
$10+10=20$
$10+11=21$
$10+12=22$

$11+1=12$
$11+2=13$
$11+3=14$
$11+4=15$
$11+5=16$
$11+6=17$
$11+7=18$
$11+8=19$
$11+9=20$
$11+10=21$
$11+11=22$
$11+12=23$

$12+1=13$
$12+2=14$
$12+3=15$
$12+4=16$
$12+5=17$
$12+6=18$
$12+7=19$
$12+8=20$
$12+9=21$
$12+10=22$
$12+11=23$
$12+12=24$

1. How many are 1 and 1? 1 and 2? 1 and 3? 1 and 4? 1 and 5? 1 and 6? 1 and 7? 1 and 8? 1 and 9? 1 and 10? 1 and 11? 1 and 12?

2. How many are 2 and 1? 2 and 2? 2 and 3? 2 and 4? 2 and 5? 2 and 6? 2 and 7? 2 and 8? 2 and 9? 2 and 10? 2 and 11? 2 and 12?

3. How many are 3 and 1? 3 and 2? 3 and 3? 3 and

4? 3 and 5? 3 and 6? 3 and 7? 3 and 8? 3 and 9? 3 and 10? 3 and 11? 3 and 12?

4. How many are 4 and 1? 4 and 2? 4 and 3? 4 and 4? 4 and 5? 4 and 6? 4 and 7? 4 and 8? 4 and 9? 4 and 10? 4 and 11? 4 and 12?

5. How many are 5 and 1? 5 and 2? 5 and 3? 5 and 4? 5 and 5? 5 and 6? 5 and 7? 5 and 8? 5 and 9? 5 and 10? 5 and 11? 5 and 12?

6. How many are 6 and 1? 6 and 2? 6 and 3? 6 and 4? 6 and 5? 6 and 6? 6 and 7? 6 and 8? 6 and 9? 6 and 10? 6 and 11? 6 and 12?

7. How many are 7 and 1? 7 and 2? 7 and 3? 7 and 4? 7 and 5? 7 and 6? 7 and 7? 7 and 8? 7 and 9? 7 and 10? 7 and 11? 7 and 12?

8. How many are 8 and 1? 8 and 2? 8 and 3? 8 and 4? 8 and 5? 8 and 6? 8 and 7? 8 and 8? 8 and 9? 8 and 10? 8 and 11? 8 and 12?

9. How many are 9 and 1? 9 and 2? 9 and 3? 9 and 4? 9 and 5? 9 and 6? 9 and 7? 9 and 8? 9 and 9? 9 and 10? 9 and 11? 9 and 12?

10. How many are 10 and 1? 10 and 2? 10 and 3? 10 and 4? 10 and 5? 10 and 6? 10 and 7? 10 and 8? 10 and 9? 10 and 10? 10 and 11? 10 and 12?

LESSON II.

1. Henry had 2 cents, and his mother gave him 1 more. How many cents had he then?

Solution: He had the sum of 2 cents and 1 cent, which is 3 cents. *Answer:* 3 cents.

2. Charles had 2 marbles, and found 2 more. How many marbles had he then?

3. Mary picked 3 roses, and Emma picked 2. How many did both pick?

4. John gathered 4 quarts of chestnuts, and William gathered 2 quarts. How many quarts did both gather?

5. If a vest cost 2 dollars, and a coat 5 dollars, what will both cost?

6. There are 6 eggs in one nest, and 2 in another. How many eggs are in both nests?

7. George killed 2 quails, and James killed 7. How many quails did both kill?

8. A farmer had 8 hogs, and bought 2 more. How many had he then?

9. Emily found 2 pins, and her sister found 9. How many did both find?

10. There are 10 bars of soap in one box, and 2 in another. How many bars are in both?

11. Julia is 3 years old. What will be her age in 3 years more?

12. Edward recited 4 lessons in the morning, and 3 in the afternoon. How many lessons did he recite altogether?

13. There are 3 birds in one cage, and 5 in another. What is the total number?

14. Susan bought 6 yards of muslin at one store, and 3 yards at another. How many yards had she then?

15. Harry's father gave him 3 cents, and his mother gave him 7 cents. How much money had he then?

16. Allan bought 8 oranges, and Arthur bought 3. How many did both buy?

17. Ella gave 3 cents for a lead-pencil, and 9 cents for a blank book. How much did she pay for both?

18. There are 10 pears on one branch, and 3 on another. How many pears are on both branches?

19. Alice has 4 apples, and her brother has 4. How many apples have they together?

20. Elmore picked 5 quarts of cherries, and Joseph picked 4 quarts. How many quarts did both pick?

21. A farmer planted 4 acres of land in potatoes, and 6 acres in corn. How many acres were planted?

22. Anna made 7 pies, and Kate made 4. How many pies did both make?

23. A man can chop 8 cords of wood in a week, and his son can chop 4 cords. How many cords can both chop?

24. There are 4 horses in one pasture, and 9 in another. How many horses are in both?

25. If it is 10 miles from Cincinnati to Reading, and 4 miles farther from Reading to Sharon, how far is it from Cincinnati to Sharon?

26. Jasper had 5 books, and he bought 5 more. How many had he then?

27. If a cord of wood is worth $6, and a ton of coal $5, what is their combined value?

28. Frank caught 5 fishes, and Samuel caught 7. How many did both catch?

29. Jennie canned 8 quarts of plums, and Clara canned 5 quarts. How many quarts were canned?

30. There are 5 pupils in one class, and 9 in another. How many are in the two classes?

31. There are 10 letters in one word, and 5 in another. How many letters are in both words?

32. A flour-dealer sold 6 barrels of flour to one merchant, and 7 barrels to another. How many barrels did he sell?

33. A farmer sold 8 bushels of potatoes at one time, and 6 bushels at another. How many bushels were sold?

34. A lady bought 6 yards of ribbon of one kind, and 9 yards of another kind? How many yards did she buy?

35. In a certain class there are 10 boys and 6 girls. How many pupils are in the class?

36. There are 7 doves in one tree, and 8 doves in another. How many are there altogether?

37. A coat cost 9 dollars, and a pair of boots 7 dollars. What was the total cost?

38. I planted 7 pear trees and 10 apple trees. How many trees were planted?

39. Robert worked 8 days for one man, and 9 days for another. How many days did he work?

40. Frederick owns 9 ducks, and his brother owns 10. How many ducks do both own?

41. Walter had 10 cents, and he found 10 more. How many cents had he then?

42. Rose worked 11 problems, and Lily worked 10. How many problems did both work?

43. Isaac earned 10 dimes, and Ezra earned 12. How many dimes had they then?

44. Lewis fed his horse 12 ears of corn on Friday, and 12 ears on Saturday. How many ears were required?

LESSON III.

1. Five and 7 are how many? 5 and 9? 5 and 12? 5 and 15? 6 and 8? 6 and 11? 6 and 16? 6 and 19?

2. Seven and 9 are how many? 7 and 11? 7 and 14? 7 and 18? 8 and 10? 8 and 13? 8 and 16? 8 and 19?

3. Nine and 12 are how many? 9 and 16? 9 and 19? 9 and 21? 10 and 11? 10 and 14? 10 and 17? 10 and 20?

4. Eleven and 3 are how many? 11 and 5? 11 and 8? 11 and 12? 12 and 6? 12 and 9? 12 and 13? 12 and 18?

5. Thirteen and 6 are how many? 13 and 9? 13 and 13? 13 and 17? 14 and 7? 14 and 11? 14 and 16? 14 and 20?

6. Fifteen and 7 are how many? 15 and 10? 15 and 15? 15 and 21? 16 and 8? 16 and 11? 16 and 13? 16 and 19?

7. Seventeen and 9 are how many? 17 and 13? 17 and 17? 17 and 20? 18 and 7? 18 and 12? 18 and 17? 18 and 22?

8. Nineteen and 8 are how many? 19 and 11? 19 and 15? 19 and 20? 20 and 12? 20 and 17? 20 and 21? 20 and 25?

9. Twenty-six and 7 are how many? 7 and 36? 46 and 7? 7 and 56? 66 and 7? 7 and 76? 86 and 7? 7 and 96?

10. How many are 28 and 8? 8 and 38? 48 and 8? 8 and 58? 68 and 8? 8 and 78? 88 and 8? 8 and 98?

11. How many are 26 and 9? 9 and 36? 46 and 9? 9 and 56? 66 and 9? 9 and 76? 86 and 9? 9 and 96?

12. How many are 25 and 6? 6 and 35? 45 and 6? 6 and 55? 65 and 6? 6 and 75? 85 and 6? 6 and 95?

13. How many are 27 and 9? 9 and 37? 47 and 9? 9 and 57? 67 and 9? 9 and 77? 87 and 9? 9 and 97?

14. How many are 24 and 7? 7 and 34? 44 and 7? 7 and 54? 64 and 7? 7 and 74? 84 and 7? 7 and 94?

15. How many are 25 and 8? 8 and 35? 45 and 8? 8 and 55? 65 and 8? 8 and 75? 85 and 8? 8 and 95?

16. How many are 29 and 9? 9 and 39? 49 and 9? 9 and 59? 69 and 9? 9 and 79? 89 and 9? 9 and 99?

17. How many are 21 and 10? 10 and 31? 41 and 10? 10 and 51? 61 and 10? 10 and 71? 81 and 10? 10 and 91?

18. How many are 7 and 15? 25 and 7? 7 and 35? 45 and 7? 7 and 55? 65 and 7? 7 and 75? 85 and 7? 7 and 95?

19. How many are 26 and 11? 11 and 36? 46 and 11? 11 and 56? 66 and 11? 11 and 76? 86 and 11? 11 and 96?

20. How many are 28 and 12? 12 and 38? 48 and 12? 12 and 58? 68 and 12? 12 and 78? 88 and 12? 12 and 98?

21. How many are 6 and 13? 14 and 9? 7 and 18? 15 and 8? 5 and 17? 16 and 4? 19 and 3? 20 and 0?

22. How many are 23 and 5? 6 and 22? 4 and 29? 27 and 8? 7 and 28? 26 and 9? 25 and 3?

23. How many are 35 and 7? 5 and 39? 32 and 8? 4 and 37? 6 and 38? 36 and 3? 9 and 34?

24. How many are 46 and 4? 7 and 47? 49 and 3? 6 and 45? 43 and 8? 5 and 44? 9 and 48?

25. How many are 55 and 8? 6 and 59? 54 and 7? 4 and 58? 56 and 5? 3 and 57? 9 and 53?

26. How many are 63 and 8? 4 and 69? 66 and 9? 5 and 67? 64 and 7? 6 and 68? 3 and 65?

27. How many are 74 and 6? 5 and 78? 77 and 7? 3 and 79? 76 and 4? 8 and 73? 75 and 9?

28. How many are 83 and 7? 5 and 88? 85 and 6? 4 and 89? 86 and 8? 84 and 10? 9 and 87?

29. How many are 95 and 7? 4 and 96? 93 and 8? 5 and 97? 94 and 6? 9 and 98? 99 and 10?

LESSON IV.

What is the sum of

1. Five and 3 and 2 and 6?
2. Seven and 4 and 5 and 3?
3. Nine and 6 and 7 and 5?
4. Three and 8 and 4 and 9?
5. Eight and 5 and 3 and 7?
6. Six and 9 and 4 and 8?
7. Ten and 5 and 6 and 7?
8. Eleven and 3 and 8 and 6?

9. Twelve and 4 and 7 and 9?

10. Thirteen and 5 and 8 and 6?

11. Fourteen and 6 and 4 and 8 and 3?

12. Fifteen and 8 and 5 and 7 and 4 and 9?

13. Sixteen and 7 and 3 and 6 and 8 and 5 and 2?

14. Seventeen and 5 and 7 and 4 and 9 and 3 and 6 and 8?

15. Eighteen and 8 and 6 and 9 and 5 and 7 and 4 and 3?

16. Nineteen and 9 and 8 and 7 and 6 and 5 and 4 and 3?

17. Twenty-seven and 6 and 4 and 8 and 5 and 7 and 9 and 2?

18. Thirty-three and 7 and 5 and 9 and 3 and 6 and 4 and 8?

19. Forty-five and 4 and 7 and 3 and 9 and 5 and 8 and 6?

20. Fifty-eight and 8 and 5 and 7 and 9 and 4 and 6 and 10?

21. Sixty-four and 9 and 3 and 8 and 5 and 7 and 4 and 6?

22. Seventy-six and 10 and 7 and 5 and 3 and 8 and 4 and 9?

23. Eighty-two and 7 and 3 and 6 and 4 and 8 and 9 and 5?

24. Ninety-nine and 9 and 8 and 7 and 6 and 5 and 4 and 3?

25. One hundred and 3 and 4 and 5 and 6 and 7 and 8 and 9?

26. $19+5+2+6+1+8+3+9+4+7=?$

27. $27+6+1+9+2+7+3+5+4+8=?$

28. $35+7+3+6+1+8+4+9+7+5=?$

29. $46+4+6+5+8+2+7+1+9+3=?$

30. $54+8+3+7+6+1+9+5+2+4=?$

31. 68 + 2 + 7 + 5 + 3 + 8 + 1 + 6 + 9 + 8 = ?
32. 73 + 1 + 6 + 2 + 8 + 3 + 7 + 4 + 9 + 5 = ?
33. 82 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = ?
34. 91 + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = ?
35. 10 + 12 + 14 + 16 + 18 + 20 + 22 + 24 + 26 = ?

NOTE.—*Add the units and the tens separately, and unite their sums.*

36. 11 + 13 + 15 + 17 + 19 + 21 + 23 + 25 + 27 = ?
37. 13 + 16 + 19 + 22 + 25 + 27 + 29 + 31 + 33 = ?
38. 17 + 22 + 28 + 34 + 40 + 46 + 52 + 58 + 64 = ?
39. 24 + 31 + 42 + 53 + 67 + 76 + 85 + 98 + 100 = ?
40. 19 + 32 + 87 + 64 + 45 + 78 + 26 + 53 + 91 = ?

41. A boy gave 5 cents for a top, 7 cents for a kite, and 8 cents for a ball. How many cents did he spend?

42. There are 10 pupils in one class, 7 in another, and 9 in another. How many pupils are in the three classes?

43. A has 12 marbles, B has 10, and C has 8. How many have all?

44. There are 15 chickens in one coop, 13 in another, and 17 in another. What is the total number?

45. I picked 14 quarts of cherries on Monday, 16 quarts on Tuesday, 18 quarts on Wednesday, and 20 quarts on Thursday. How many quarts were picked altogether?

46. A horse cost $75, a buggy $85, and a set of harness $15. How much did all cost?

47. There are 45 acres in one farm, 37 acres in another, 56 acres in a third, and 64 acres in a fourth. How many acres are in the four farms?

48. Four loads of corn measured respectively 39 bushels, 47 bushels, 38 bushels, and 45 bushels. Find the whole number of bushels?

49. There are five bolts of cloth containing respectively 18 yards, 19 yards, 21 yards, 23 yards, and 25 yards. How many yards in all?

50. The head of a fish is 10 inches long, the tail 15 inches, and the body is as long as the head and tail together. What is the length of the fish?

51. A horse cost $60, a cart $15, and a buggy as much as both horse and cart. What was the total cost?

52. John weighs 57 pounds, Henry 68, and their father weighs 50 pounds more than both. How much do all weigh?

SUBTRACTION.

Lesson V.

Subtraction is the process of finding the difference between two numbers.

The larger number is called the *minuend.* The smaller is termed the *subtrahend.* The result is the *difference,* or *remainder.*

The *sign* of subtraction is —, and is read *minus,* or *less.* When placed between two numbers it shows that the number upon the right of it is to be taken from the other number. Thus, $5-3=2$.

SUBTRACTION TABLE.

1—1= 0
2—1= 1
3—1= 2
4—1= 3
5—1= 4
6—1= 5
7—1= 6
8—1= 7
9—1= 8
10—1= 9
11—1=10
12—1=11

2—2= 0
3—2= 1
4—2= 2
5—2= 3
6—2= 4
7—2= 5
8—2= 6
9—2= 7
10—2= 8
11—2= 9
12—2=10
13—2=11

3—3= 0
4—3= 1
5—3= 2
6—3= 3
7—3= 4
8—3= 5
9—3= 6
10—3= 7
11—3= 8
12—3= 9
13—3=10
14—3=11

4—4= 0
5—4= 1
6—4= 2
7—4= 3
8—4= 4
9—4= 5
10—4= 6
11—4= 7
12—4= 8
13—4= 9
14—4=10
15—4=11

5—5= 0
6—5= 1
7—5= 2
8—5= 3
9—5= 4
10—5= 5
11—5= 6
12—5= 7
13—5= 8
14—5= 9
15—5=10
16—5=11

6—6= 0
7—6= 1
8—6= 2
9—6= 3
10—6= 4
11—6= 5
12—6= 6
13—6= 7
14—6= 8
15—6= 9
16—6=10
17—6=11

7—7= 0
8—7= 1
9—7= 2
10—7= 3
11—7= 4
12—7= 5
13—7= 6
14—7= 7
15—7= 8
16—7= 9
17—7=10
18—7=11

8—8= 0
9—8= 1
10—8= 2
11—8= 3
12—8= 4
13—8= 5
14—8= 6
15—8= 7
16—8= 8
17—8= 9
18—8=10
19—8=11

9—9= 0
10—9= 1
11—9= 2
12—9= 3
13—9= 4
14—9= 5
15—9= 6
16—9= 7
17—9= 8
18—9= 9
19—9=10
20—9=11

10—10= 0
11—10= 1
12—10= 2
13—10= 3
14—10= 4
15—10= 5
16—10= 6
17—10= 7
18—10= 8
19—10= 9
20—10=10
21—10=11

11—11= 0
12—11= 1
13—11= 2
14—11= 3
15—11= 4
16—11= 5
17—11= 6
18—11= 7
19—11= 8
20—11= 9
21—11=10
22—11=11

12—12= 0
13—12= 1
14—12= 2
15—12= 3
16—12= 4
17—12= 5
18—12= 6
19—12= 7
20—12= 8
21—12= 9
22—12=10
23—12=11

1. One from 3 leaves how many? one from 8? from 5? from 9? from 12?

2. Two from 3 leaves how many? two from 6? from 9? from 5? from 11?

3. Three from 5 leaves how many? three from 8? from 6? from 9? from 13?

4. Four from 7 leaves how many? four from 9? from 11? from 8? from 15?

5. Five from 9 leaves how many? five from 12? from 15? from 19? from 22?

6. Six from 11 leaves how many? six from 14? from 18? from 25? from 30?

7. Seven from 13 leaves how many? seven from 15? from 19? from 24? from 32?

8. Eight from 15 leaves how many? eight from 19? from 25? from 34? from 43?

9. Nine from 17 leaves how many? nine from 20? from 26? from 38? from 45?

10. Ten from 19 leaves how many? ten from 23? from 35? from 47? from 59?

11. 27—4=what? 33—5? 42—6? 54—7? 66—8? 75—9? 87—10?

12. 39—8=what? 45—7? 56—6? 63—4? 72—5? 81—8? 97—9?

13. 46—5=what? 51—4? 63—7? 78—6? 83—9? 95—8? 110—10?

14. 55—6=what? 62—7? 74—5? 89—8? 91—3? 106—9? 107—10?

15. 61—2=what? 77—9? 85—6? 94—7? 109—10? 57—8? 42—5?

16. 18—7=what? 26—8? 33—4? 41—5? 52—3? 64—6? 75—10?

17. 24—9=what? 31—6? 47—10? 53—5? 62—4? 76—8? 88—9?

18. 32—3=what? 43—7? 54—6? 60—4? 71—9? 85 -5? 96—9?

19. 73—10=what? 81—5? 92—7? 54—8? 45—6? 67—9? 100—12?

20. 55—2—3—4—5—6—7—8—9—10= ?

Suggestion: Add the numbers following the minus signs, and subtract their sum from the first number.

21. 76—2—4—6—8—10—12—14—16= ?

22. 111—5—2 -6—3—7—4—8—5—9—10—12= ?

23. 123—7—9—3—8—4—6—5—2—1—11—21= ?

24. 132—10—2—8—4—7—5—9—6—3—13—15= ?

25. 144—8—10—4—7—5—2—3—6—9—17—20= ?

26. 156—11- 7—8—10—6—12—4—9—5—15—25=?

27. 167—13—12—10—9-8—5—7—4-6—24—36=?

28. 178—9—9—9—9—9—9—9—9—9—9—9= ?

29. 189—12—11—10—9—8—7—6—5—4—3—2—1= ?

30. 200—1—3—5—7—9—11—13—15—17—19?

LESSON VI.

1. A boy having 15 cents spent 5 cents for a lead-pencil. How many cents had he then?

Solution: He had the difference between 15 cents and 5 cents, which is 10 cents. *Answer:* 10 cents.

2. A farmer who owned 40 sheep, sold 9 of them. How many sheep remained?

3. Harry picked 57 cherries, and gave his sister all but 27. How many did she receive?

4. A man owed a debt of 75 dollars, and paid it all but 30 dollars. How much did he pay?

5. A traveled 99 miles in 6 days, and B traveled 48 miles in 3 days. How much farther did A travel than B?

6. Mr. Jones owns 100 acres of land, and Mr. Smith owns 67 acres. How many acres less than Mr. Jones *does Mr. Smith* own?

7. A team of mules cost 86 dollars, and a yoke of oxen 47 dollars. What was their difference in value?

8. Out of a flock of 84 pigeons, 29 were killed. How many escaped?

9. A reader contains 96 pages, and a spelling-book 77. How many more pages are in the reader than in the other?

10. A farmer plowed 73 rows of corn, and his son plowed 56 rows. How many rows less did the son plow than the father?

11. A watch is worth 100 dollars, and a chain 33 dollars. What is their difference in value?

12. A clothes-line 100 feet long was cut into two pieces. The shorter piece was 47 feet in length. How long was the other piece?

13. One grass-plot contains 126 square feet, and another contains 98 square feet. What is their difference in area?

14. The solid contents of one oak log are 144 cubic feet, and of another 108 cubic feet. What is the difference of their contents?

15. Milton's hens laid 161 eggs during a certain week, and Oliver's hens laid 127. How many less than Milton's did Oliver's hens lay?

16. One of George's pigs weighs 139 pounds, and another weighs 175 pounds. What is their difference in weight?

17. Two boys gathered 183 walnuts. One took 91. How many did the other take?

18. The distance from A to B is 194 miles, which is 69 miles farther than the distance from B to C. How far is it from B to C?

19. Judson's library contains 200 volumes; Jackson's contains 34 volumes less. How many volumes are in *Jackson's library?*

20. The difference in the cost of two wagons was 63 dollars. If one cost 151 dollars, what did the other cost?

21. There are 147 apples on one tree, and 201 on another. How many fewer are there on the first than on the second?

22. A trader bought 125 head of cattle, and then sold all but 49. How many did he sell?

23. A certain post-office received 183 letters in one week, and sent away 156. How many more were received than sent?

24. Herbert's father and mother gave him 175 cents on Christmas day. If he received 99 cents from his father, how many did his mother give?

25. From a barrel of flour containing 196 pounds, 58 pounds were taken out at one time, and 87 pounds at another. How many pounds remained?

26. Three boys together had 159 marbles. The first had 54, and the second 52. How many belonged to the third?

27. The sum of the ages of A, B, and C is 110 years. A's age is 49 years; B is 11 years younger. How old is C?

28. Brown and Robinson bought 169 acres of land. Brown's share was 72 acres. How many more acres did Robinson own than Brown?

29. A horse and buggy together cost 195 dollars. If the horse cost 115 dollars, what was the difference in their value?

30. A farmer's sheep are in three fields. The first field contains 83, which is 16 more than the number in the second. If the entire number is 200, how many are in the third field?

31. 196 men were engaged in a skirmish. 57 were wounded, which was 29 more than the number killed. How many were unhurt?

32. A man traveled 182 miles in 3 days. He went 75 miles the first day, and 38 miles less the second. How far did he travel the third day?

33. A has 131 dollars, which is 45 dollars more than B has. If C's money is 49 dollars less than B's, how much has C?

34. A dealer sold a lot of lumber for 150 dollars, thereby gaining 23 dollars. How much would he have gained had he sold it for 167 dollars?

35. From the difference between 107 and 195 subtract the difference between 123 and 36.

36. The sum of two numbers, plus their difference, equals 173. If their difference is 48, what is their sum?

37. The difference of two numbers, plus their sum, equals 184. If their sum is 147, what is their difference?

38. The sum of two numbers is 169. One of them is 122. What is their difference?

39. If 50 be added to the difference of two numbers, the sum will be 144. If 136 is one of the numbers, what is the other?

40. The sum of two numbers is 200. If 68 be subtracted from the sum, the result will be 45 more than the less number. What is the greater number?

ADDITION AND SUBTRACTION.

LESSON VII.

What is the value of

1. 10+ 6— 4?
2. 8+ 5— 3?
3. 11+ 7— 5?
4. 9+ 8— 6?
5. 12+ 9— 7?
6. 7+10— 8?
7. 13+ 4— 9?
8. 15+ 7— 5?
9. 18+ 8—10?
10. 16+ 9— 6?
11. 20— 5+ 8?
12. 23— 7+ 5?
13. 25— 9+ 4?
14. 19— 8+11?
15. 22—10+ 7?
16. 27— 8+ 6?
17. 24— 9+10?
18. 26— 7+ 9?
19. 29— 9+12?
20. 30— 6+11?
21. 11+ 9— 6+ 5— 7?
22. 24+ 7— 4+ 8— 3?
23. 35+ 6— 9+ 2— 5?
24. 42+ 8— 5+ 7— 6?
25. 57+10— 8+ 3— 4?
26. 63— 7+ 5— 8+ 6?
27. 79— 4+ 7— 9+10?
28. 86— 9+ 6— 3+ 8?
29. 98—10+ 7— 9+11?
30. 100— 8+ 5— 7+10?

31. A man having 50 dollars, lost 10, borrowed 15, and afterward spent 25. How much money had he then?

32. Two boys began to play marbles, each having 25. When they quit, one had 17. How many had the other?

33. A trader exchanged a horse worth 84 dollars for a wagon worth 72 dollars, and 28 dollars in money. How much did he gain?

34. I gave 75 dollars for a horse. After paying 27 dollars for his board, and hiring him out for 42 dollars, I sold him for 50 dollars. Find my loss on the transaction.

35. Lucy had 46 chestnuts. Her father gave her 24, her mother 18, and her sister enough to make 100. How many did her sister give?

36. A owns 56 acres of land, which is 16 acres more than B owns. If C has 24 acres more than B, how many acres have all?

37. A farmer having 99 bushels of corn, sold 42 bushels to one man, and 7 bushels more than that to another. How many bushels had he remaining?

38. Mr. Wilson had a certain number of sheep. 10 died. He then bought 27, sold 49, and had 43 left. How many had he at first?

39. What number is that from which if you take 92—47, the remainder will be 55?

40. What number is that from which if 28 be taken, the remainder will be 93—39?

41. What number is that to which if 66—37 be added, the sum will be 96?

42. What number is that to which if 42 be added, the sum will be 99—25?

43. There is a number which is as much less than 91 as 64 is greater than 45. What is the number?

44. There is a number which is as much greater than 47 as 31 is less than 59. What is the number?

45. A man made a journey of 100 miles in 3 days. He went 25 miles the first day, and 10 miles farther the second day. How far did he go the third day?

46. A laborer worked 21 days in May, 4 days less in June, and 9 days more in July than in June. How many days did he work altogether?

47. A suit of clothes cost 38 dollars. The coat cost 23 dollars, which was 18 dollars more than the price of the vest. What did the pants cost?

48. A raised 30 chickens, which was 12 less than B

raised. C raised 15 less than B. How many chickens did all raise.

49. A trader sold a horse for 93 dollars, thereby gaining 28 dollars. How much would he have lost if he had sold him for 50 dollars?

50. A merchant bought 3 bolts of cloth. The first contained 34 yards, which was 7 yards more than there were in the second. The third contained 25 yards less than the other two combined. What was the total number?

51. Four men built 100 rods of fence. The first built 19 rods. The second, 13 rods more. The third, 11 rods less than the second. How many rods did the fourth build?

52. A lady bought a dress pattern for 17 dollars, trimmings for 6 dollars, and a cloak for 18 dollars. She gave the clerk a fifty-dollar bill, and received 10 dollars change. How much was this incorrect?

MULTIPLICATION.

LESSON VIII.

MULTIPLICATION is the process of taking a number a given number of times, and is, therefore, a short method of performing several additions of the same number.

The *multiplicand* is the number to be multiplied.

The *multiplier* is the number by which we multiply, and it shows how many times the multiplicand is to be taken.

The *product* is the result of multiplication.

The multiplicand and multiplier are called the *factors* of the product.

The *sign* of multiplication is ×, and is read *multiplied by*, or, *times*. Thus, $3\times 7=21$ may be read 3 multiplied by $7=21$, or, 3 times 7 are 21.

If either factor be taken for the multiplier, the result is the same.

MULTIPLICATION TABLE.

$1\times 1=1$
$1\times 2=2$
$1\times 3=3$
$1\times 4=4$
$1\times 5=5$
$1\times 6=6$
$1\times 7=7$
$1\times 8=8$
$1\times 9=9$
$1\times 10=10$
$1\times 11=11$
$1\times 12=12$

$2\times 1=2$
$2\times 2=4$
$2\times 3=6$
$2\times 4=8$
$2\times 5=10$
$2\times 6=12$
$2\times 7=14$
$2\times 8=16$
$2\times 9=18$
$2\times 10=20$
$2\times 11=22$
$2\times 12=24$

$3\times 1=3$
$3\times 2=6$
$3\times 3=9$
$3\times 4=12$
$3\times 5=15$
$3\times 6=18$
$3\times 7=21$
$3\times 8=24$
$3\times 9=27$
$3\times 10=30$
$3\times 11=33$
$3\times 12=36$

$4\times 1=4$
$4\times 2=8$
$4\times 3=12$
$4\times 4=16$
$4\times 5=20$
$4\times 6=24$
$4\times 7=28$
$4\times 8=32$
$4\times 9=36$
$4\times 10=40$
$4\times 11=44$
$4\times 12=48$

$5\times 1=5$
$5\times 2=10$
$5\times 3=15$
$5\times 4=20$
$5\times 5=25$
$5\times 6=30$
$5\times 7=35$
$5\times 8=40$
$5\times 9=45$
$5\times 10=50$
$5\times 11=55$
$5\times 12=60$

$6\times 1=6$
$6\times 2=12$
$6\times 3=18$
$6\times 4=24$
$6\times 5=30$
$6\times 6=36$
$6\times 7=42$
$6\times 8=48$
$6\times 9=54$
$6\times 10=60$
$6\times 11=66$
$6\times 12=72$

$7\times 1=7$
$7\times 2=14$
$7\times 3=21$
$7\times 4=28$
$7\times 5=35$
$7\times 6=42$
$7\times 7=49$
$7\times 8=56$
$7\times 9=63$
$7\times 10=70$
$7\times 11=77$
$7\times 12=84$

$8\times 1=8$
$8\times 2=16$
$8\times 3=24$
$8\times 4=36$
$8\times 5=40$
$8\times 6=48$
$8\times 7=56$
$8\times 8=64$
$8\times 9=72$
$8\times 10=80$
$8\times 11=88$
$8\times 12=96$

$9 \times 1 = 9$
$9 \times 2 = 18$
$9 \times 3 = 27$
$9 \times 4 = 36$
$9 \times 5 = 45$
$9 \times 6 = 54$
$9 \times 7 = 63$
$9 \times 8 = 72$
$9 \times 9 = 81$
$9 \times 10 = 90$
$9 \times 11 = 99$
$9 \times 12 = 108$

$10 \times 1 = 10$
$10 \times 2 = 20$
$10 \times 3 = 30$
$10 \times 4 = 40$
$10 \times 5 = 50$
$10 \times 6 = 60$
$10 \times 7 = 70$
$10 \times 8 = 80$
$10 \times 9 = 90$
$10 \times 10 = 100$
$10 \times 11 = 110$
$10 \times 12 = 120$

$11 \times 1 = 11$
$11 \times 2 = 22$
$11 \times 3 = 33$
$11 \times 4 = 44$
$11 \times 5 = 55$
$11 \times 6 = 66$
$11 \times 7 = 77$
$11 \times 8 = 88$
$11 \times 9 = 99$
$11 \times 10 = 110$
$11 \times 11 = 121$
$11 \times 12 = 132$

$12 \times 1 = 12$
$12 \times 2 = 24$
$12 \times 3 = 36$
$12 \times 4 = 48$
$12 \times 5 = 60$
$12 \times 6 = 72$
$12 \times 7 = 84$
$12 \times 8 = 96$
$12 \times 9 = 108$
$12 \times 10 = 120$
$12 \times 11 = 132$
$12 \times 12 = 144$

How many are

1. 4 times 5? 7 times 2? 6 times 3? 5 times 8?
2. 2 times 9? 8 times 6? 7 times 9? 10 times 4?
3. 9 times 5? 4 times 8? 6 times 7? 11 times 6?
4. 7 times 8? 6 times 9? 5 times 12? 8 times 9?
5. 6 times 12? 9 times 10? 11 times 7? 8 times 7?
6. 5 times 7? 12 times 6? 9 times 9? 7 times 12?
7. 8 times 12? 7 times 6? 12 times 4? 11 times 9?
8. 3 times 9? 11 times 7? 8 times 8? 9 times 7?
9. 10 times 11? 12 times 9? 7 times 10? 9 times 11?
10. 12 times 5? 7 times 7? 6 times 12? 4 times 9?
11. 11 times 6? 9 times 8? 12 times 7? 8 times 11?
12. 5 times 9? 6 times 6? 6 times 12? 12 times 10?
13. 7 times 5? 10 times 12? 6 times 8? 11 times 11?
14. 12 times 11? 11 times 10? 4 times 12? 12 times 12?

LESSON IX.

1. At 2 cents each, what will 5 oranges cost?

Solution: If 1 orange costs 2 cents, 5 oranges will cost 5 times 2 cents, which is 10 cents. *Answer:* 10 cents.

2. If one apple is worth 6 plums, how many plums are 4 apples worth?

3. Edward has 7 marbles, and Oliver has 5 times as many. How many has Oliver?

4. There are 8 sheep in one pen, and 6 times as many in another. How many sheep are in the second pen?

5. Samuel has 8 times as many marbles as Herbert. If Herbert has 5 marbles, how many has Samuel?

6. There are 9 pears on one tree, and 4 times that number on another. How many pears are on the second tree?

7. A laborer worked 7 weeks at 6 dollars per week. How many dollars did he earn?

8. In an orchard there are 8 cherry trees, and 9 times as many apple trees. What is the number of apple trees?

9. There are 4 quarts in a gallon. How many quarts are in 12 gallons?

10. In a school-room there are seven rows of desks, and there are 8 desks in a row. How many desks are in the room?

11. If an ox is worth 10 sheep, how many sheep are 10 oxen worth?

12. Exchanged 9 barrels of flour for peaches, at the rate of 6 bushels for 1 barrel. How many bushels of peaches were required?

13. A merchant bought 8 boxes of starch, each containing 12 packages. What was the total number of packages?

14. A vessel containing 7 gallons was emptied 9 times into a hogshead. How many gallons were contained in the hogshead?

15. If a coach travels 8 miles an hour, how far will it go in 11 hours?

16. A teamster hauled 9 loads of gravel every day for 12 days. How many loads did he haul altogether?

17. A team of horses consumed 11 pecks of corn a week for 11 weeks. How many pecks were consumed?

18. If 10 men can do a piece of work in 12 days, how long would it take 1 man?

19. 9 men can build a wall in 8 days. How many men could build it in 1 day?

20. If 75 cords of wood can be cut by 6 men in 9 days, in what time could 1 man cut the same quantity?

21. If 250 acres of land can be plowed by 12 men in 11 days, how many men would be required to do the same work in 1 day?

Find the cost of

22. 13 loaves of bread at 7 cents a loaf.
23. 15 bushels of coal at 9 cents a bushel.
24. 16 tons of hay at 10 dollars a ton.
25. 14 barrels of sugar at 11 dollars a barrel.
26. 17 pounds of beef at 8 cents a pound.
27. 19 yards of muslin at 6 cents a yard.
28. 18 dozen eggs at 12 cents a dozen.
29. 20 chickens at 15 cents apiece.
30. 25 boxes of tobacco at 8 dollars a box.
31. 28 cords of wood at 5 dollars a cord.
32. 32 pairs of lace curtains at 9 dollars a pair.
33. 39 hogs at 7 dollars a head.
34. 47 gross of crayons at 12 cents a gross.
35. 6 silver watches at 45 dollars apiece.

36. 8 bales of cotton at 51 dollars a bale.

37. 7 hogsheads of molasses at 29 dollars a hogshead.

38. 9 head of horses at 75 dollars a head.

39. 5 turkeys at 87 cents apiece.

40. 11 carloads of coal at 38 dollars a carload.

41. 12 gallons of wine at 75 cents a gallon.

42. 80 acres of land at 125 dollars an acre.

LESSON X.

Review.

1. A boy having 12 marbles lost 4, and bought 10 times as many as he lost. How many had he then?

2. There are 7 blackbirds on one tree, and 6 times as many on another. How many are on both trees?

3. If a man earns 15 dollars in a week, and spends 6 dollars, how much will he save in 20 weeks?

4. A trader having 25 horses sold 15, and afterward bought 9 times as many as he had remaining. How many horses had he then?

5. B has 18 chickens, and C has 4 times as many, less 12. How many have they together?

6. A, B, and C went hunting. A killed 17 birds, B killed 3 times as many, less 15, and C killed as many as both A and B. How many did all kill?

7. James picked 13 quarts of berries, and John picked 18 quarts. If they sold them all at 5 cents a quart, what did they receive? How much more did John receive than James?

8. In a certain school there are 14 pupils in the algebra class, and 7 times as many, less 13, in the other classes. How many pupils are in the school?

9. A suit of clothes was made from 6 yards of cloth which cost 4 dollars a yard. The trimmings cost 7 dollars, and the making 9 dollars. For how much must the suit be sold to gain 10 dollars?

10. A owns 25 acres of land. B owns 4 times as much, less 19 acres. How many acres do both own?

11. Two boys started with their bicycles on the same road at the same time, one going 9 miles an hour, the other 11 miles an hour. If they met in 5 hours, how far apart were they when they started?

12. The sum of two numbers is 39. The greater is 27. What is 9 times the smaller?

13. The difference of two numbers is 17. The smaller is 8. What is 7 times the larger?

14. The sum of two numbers is 28 more than their difference. If their difference is 10, and 14 the less number, what is 5 times the greater?

15. The smaller of two numbers is 32 less than the greater. If the greater number is 56, what is twice their sum?

16. How much more will 12 tons of hay cost, at 16 dollars a ton, than 29 cords of wood, at 6 dollars a cord?

17. Henry and Julius commenced a game of marbles, each having 25. Henry won 9 from Julius; after which, Julius won 14 from Henry. How many had each then?

18. Bought 12 sheep at 3 dollars a head, and 18 more at 4 dollars a head. Sold 20 at 5 dollars apiece, and the remainder at 2 dollars each. Find my gain.

19. A horse, buggy, and set of harness cost 180 dollars. The horse cost 70 dollars, which was 45 dollars more than the price of the harness. What did the buggy cost?

20. A grocer sold 5 packages of starch, each containing 6 pounds, at 7 cents a pound, thereby gaining 60 cents. What did he pay for it?

21. A trader bought 48 hogs at 6 dollars each. He sold 25 of them at 8 dollars apiece, and the remainder at 5 dollars each. How much did he gain?

22. A man having a certain sum of money spent 15 dollars, borrowed 27, lent 44, found 20, and then had 88 dollars. How much had he at first?

23. Sold 15 dozen eggs at 12 cents a dozen, thereby losing 30 cents. For how much should they have been sold to gain 45 cents?

24. George owns 24 books; Frank has 3 times as many, less 16, and Hiram has 10 less than the others combined. How many do all own?

25. Bought a horse for 75 dollars; paid 3 dollars a week for his board, and received 9 dollars a week for his work. At the end of 15 weeks I sold him for 60 dollars. How much did I gain?

26. Paid 125 dollars for a gold watch, which was 18 dollars more than its value. I sold it for 17 dollars less than its value. What did I get for it?

27. Multiply the sum of 19 and 11 by their difference, and subtract the result from 300.

28. From 12 times 15 subtract 9 times 16, and multiply the remainder by 6.

29. If 16 be added to the difference of two numbers the sum will be 7 more than the greater number, which is 56. What is the less number?

30. A has 48 chestnuts, which is 17 less than B has. If C has 25 less than B, and D has 7 more than C, how many have all?

DIVISION.

LESSON XI.

DIVISION is the process of finding how often one number is contained in another, or of finding one of the equal parts of a number.

The number to be divided is called the *dividend.*

The number to divide by is called the *divisor.*

The result of the division is called the *quotient,* and it shows how many times the dividend contains the divisor.

A *remainder* is what is left when the dividend does not exactly contain the divisor, and is always less than the divisor.

The *sign* of division is ÷, and is read *divided by.* When placed between two numbers, it indicates that the number on the left is to be divided by the number on the right of it. Thus, 10÷2=5 is read 10 divided by 2 equals 5.

DIVISION TABLE.

1÷1= 1
2÷1= 2
3÷1= 3
4÷1= 4
5÷1= 5
6÷1= 6
7÷1= 7
8÷1= 8
9÷1= 9
10÷1=10
11÷1=11
12÷1=12

2÷2= 1
4÷2= 2
6÷2= 3
8÷2= 4
10÷2= 5
12÷2= 6
14÷2= 7
16÷2= 8
18÷2= 9
20÷2=10
22÷2=11
24÷2=12

3÷3= 1
6÷3= 2
9÷3= 3
12÷3= 4
15÷3= 5
18÷3= 6
21÷3= 7
24÷3= 8
27÷3= 9
30÷3=10
33÷3=11
36÷3=12

4÷4= 1
8÷4= 2
12÷4= 3
16÷4= 4
20÷4= 5
24÷4= 6
28÷4= 7
32÷4= 8
36÷4= 9
40÷4=10
44÷4=11
48÷4=12

$5 \div 5 = 1$
$10 \div 5 = 2$
$15 \div 5 = 3$
$20 \div 5 = 4$
$25 \div 5 = 5$
$30 \div 5 = 6$
$35 \div 5 = 7$
$40 \div 5 = 8$
$45 \div 5 = 9$
$50 \div 5 = 10$
$55 \div 5 = 11$
$60 \div 5 = 12$

$6 \div 6 = 1$
$12 \div 6 = 2$
$18 \div 6 = 3$
$24 \div 6 = 4$
$30 \div 6 = 5$
$36 \div 6 = 6$
$42 \div 6 = 7$
$48 \div 6 = 8$
$54 \div 6 = 9$
$60 \div 6 = 10$
$66 \div 6 = 11$
$72 \div 6 = 12$

$7 \div 7 = 1$
$14 \div 7 = 2$
$21 \div 7 = 3$
$28 \div 7 = 4$
$35 \div 7 = 5$
$42 \div 7 = 6$
$49 \div 7 = 7$
$56 \div 7 = 8$
$63 \div 7 = 9$
$70 \div 7 = 10$
$77 \div 7 = 11$
$84 \div 7 = 12$

$8 \div 8 = 1$
$16 \div 8 = 2$
$24 \div 8 = 3$
$32 \div 8 = 4$
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$56 \div 8 = 7$
$64 \div 8 = 8$
$72 \div 8 = 9$
$80 \div 8 = 10$
$88 \div 8 = 11$
$96 \div 8 = 12$

$9 \div 9 = 1$
$18 \div 9 = 2$
$27 \div 9 = 3$
$36 \div 9 = 4$
$45 \div 9 = 5$
$54 \div 9 = 6$
$63 \div 9 = 7$
$72 \div 9 = 8$
$81 \div 9 = 9$
$90 \div 9 = 10$
$99 \div 9 = 11$
$108 \div 9 = 12$

$10 \div 10 = 1$
$20 \div 10 = 2$
$30 \div 10 = 3$
$40 \div 10 = 4$
$50 \div 10 = 5$
$60 \div 10 = 6$
$70 \div 10 = 7$
$80 \div 10 = 8$
$90 \div 10 = 9$
$100 \div 10 = 10$
$110 \div 10 = 11$
$120 \div 10 = 12$

$11 \div 11 = 1$
$22 \div 11 = 2$
$33 \div 11 = 3$
$44 \div 11 = 4$
$55 \div 11 = 5$
$66 \div 11 = 6$
$77 \div 11 = 7$
$88 \div 11 = 8$
$99 \div 11 = 9$
$110 \div 11 = 10$
$121 \div 11 = 11$
$132 \div 11 = 12$

$12 \div 12 = 1$
$24 \div 12 = 2$
$36 \div 12 = 3$
$48 \div 12 = 4$
$60 \div 12 = 5$
$72 \div 12 = 6$
$84 \div 12 = 7$
$96 \div 12 = 8$
$108 \div 12 = 9$
$120 \div 12 = 10$
$132 \div 12 = 11$
$144 \div 12 = 12$

1. Two is contained in 8 how many times? in 12? in 16? in 20? in 24?

2. Three is contained in 9 how many times? in 15? in 21? in 27? in 33?

3. Four is contained in 20 how many times? in 32? in 24? in 16? in 48?

4. Five in 30 how many times? in 45? in 20? in 35? in 60? in 15?

5. Six in 42 how many times? in 24? in 54? in 36? in 72? in 48?

6. Seven in 63 how many times? in 35? in 77? in 49? in 84? in 56?

7. Eight in 64 how many times? in 40? in 96? in 56? in 88? in 48?

8. Nine in 54 how many times? in 81? in 36? in 108? in 45? in 72?

9. Ten in 70 how many times? in 90? in 50? in 110? in 80? in 120?

10. Eleven in 66 how many times? in 99? in 121? in 77? in 44? in 132?

11. Twelve in 84 how many times? in 48? in 120? in 72? in 108? in 144?

12. 12 are how many times 2? 3? 4? 6?

13. 18 are how many times 2? 3? 6? 9?

14. 20 are how many times 2? 4? 5? 10?

15. 24 are how many times 2? 3? 4? 6? 8? 12?

16. 28 are how many times 2? 4? 7? 14?

17. 30 are how many times 2? 3? 5? 6? 10? 15?

18. 36 are how many times 2? 3? 4? 6? 9? 12? 18?

19. 40 are how many times 2? 4? 5? 8? 10? 20?

20. 48 are how many times 2? 3? 4? 6? 8? 12? 16? 24?

21. 56 are how many times 2? 4? 7? 8? 14? 28?

22. 60 are how many times 2? 3? 4? 5? 6? 10? 12? 15? 20? 30?

23. 64 are how many times 2? 4? 8? 16? 32?

24. 72 are how many times 2? 3? 4? 6? 8? 9? 12? 18? 24? 36?

25. 80 are how many times 2? 4? 5? 8? 10? 16? 20? 40?

26. 84 are how many times 2? 3? 4? 6? 7? 12? *14? 21? 28?* 42?

27. 90 are how many times 2? 3? 5? 6? 9? 10? 15? 18? 30? 45?

28. 96 are how many times 2? 3? 4? 6? 8? 12? 16? 24? 32? 48?

29. 100 are how many times 2? 4? 5? . 10? 20? 25? 50?

30. 108 are how many times 2? 3? 4? 6? 9? 12? 18? 27? 36? 54?

31. What is one half of 6? of 10? of 16? of 22? of 18? of 24? of 30?

32. What is one third of 9? of 15? of 24? of 33? of 21? of 36? of 27?

33. What is one fourth of 20? of 32? of 24? of 36? of 28? of 40? of 48?

34. What is one fifth of 15? of 35? of 50? of 30? of 55? of 60? of 75?

35. What is one sixth of 24? of 42? of 60? of 36? of 48? of 18? of 72?

36. What is one seventh of 21? of 56? of 35? of 70? of 49? of 63? of 84?

37. What is one eighth of 40? of 24? of 56? of 72? of 32? of 64? of 96?

38. What is one ninth of 36? of 63? of 90? of 72? of 45? of 81? of 108?

39. What is one tenth of 60? of 30? of 100? of 80? of 50? of 110? of 90?

40. What is one twelfth of 84? of 120? of 72? of 132? of 96? of 60? of 144?

LESSON XII.

1. If one apple cost 2 cents, how many apples can be bought for 8 cents?

Solution: As many apples as 2 cents are contained times in *8 cents, which* is 4. *Answer:* 4 apples.

2. In how many hours can a man travel 20 miles at the rate of 4 miles an hour?

3. If a supply of provisions maintain 42 persons 1 week, how long will it last 7 persons?

4. If one peach is worth 8 plums, how many peaches are 40 plums worth?

5. A man can build 6 rods of fence in a day. In how many days can he build 54 rods?

6. 56 dollars were paid for coal at 7 dollars a ton. How many tons were bought?

7. 48 dozen oysters were packed in cans, each containing 4 dozen. How many cans were required?

8. 8 quarts make a peck. How many pecks are in 64 quarts?

9. 72 apple trees were planted in 6 equal rows. How many were in each row?

10. 9 square feet make 1 square yard. How many square yards are in 99 square feet?

11. How often can a vessel containing 8 gallons be filled from a tank holding 72 gallons?

12. Seven days make a week. How many weeks are in 49 days?

13. If 81 dozen eggs were packed in boxes, each holding 9 dozen, how many boxes would be required?

14. Paid 63 dollars for flour, at 7 dollars a barrel. How many barrels were bought?

15. 96 sheep were exchanged for cows, allowing 1 cow for 8 sheep. How many cows were given?

16. A teamster hauled 60 loads of gravel, at the rate of 6 loads a day. How long was he employed?

17. 12 ounces of silver make a pound. How many pounds are in 108 ounces?

18. 75 men completed a certain work in one day. How long would it have taken 3 men?

19. A certain number of horses consumed 90 bushels of corn. If each was allowed 6 bushels, how many horses were there?

20. If a company of soldiers be allowed 7 barrels of flour a week, how long would 91 barrels last them?

21. 140 dollars were paid for hay at 10 dollars a ton. How many tons were bought?

22. 20 grains make a pennyweight. How many pennyweights are in 100 grains?

23. At 9 cents a pound, how many pounds of sugar can be bought for 198 cents?

24. Eight pints make a gallon. How many gallons are in 256 pints?

25. If a boy can run 12 feet in a second, in how many seconds can he run 480 feet?

LESSON XIII.

1. Three hunters killed 12 quails, and divided them equally. How many did each take?

Solution: Each took one third of 12 quails, which is 4 quails. *Answer:* 4 quails.

2. Five equal packages of starch weighed 35 pounds. What did each weigh?

3. Seven horses drew 42 cart-loads of coal. How many loads did each draw?

4. Four boards of the same size measured 48 square feet? How many square feet were in each board?

5. Eight loads of brick cost 72 dollars. What did one load cost?

6. Six acres of land were divided in 48 building lots. How many lots did one acre make?

7. Nine boys picked 108 quarts of berries. How many quarts did each pick?

8. Eleven miles of railroad were built in 121 days. How many days were required to build one mile?

9. Ten boxes were packed with 100 pounds of candy. How many pounds were in each box?

10. Twelve suits of clothes were made from 84 yards of cloth. How many yards were required for one suit?

11. A man earned 132 dollars in eleven weeks. How much did he earn each week?

12. If a horse can travel 54 miles in 9 hours, how far can he travel in 1 hour?

13. A laborer performed a certain work in 56 days. In what time could 7 laborers have done it?

14. Thirty-six pears were equally divided among 4 boys. What was the share of each?

15. If 110 trees be planted in 10 rows, how many trees will be in each row?

16. A father's age is 49 years, which is 7 times the age of his youngest son. What is the son's age?

17. William has 81 marbles, which is 9 times as many as John has. How many has John?

18. If 63 plums are worth 9 apples, how many plums should be given for 1 apple?

19. A merchant bought 12 barrels of sugar for 144 dollars. What was the cost per barrel?

20. If 1 pipe can fill a cistern in 56 minutes, in what time could 8 such pipes fill it?

21. What will be the cost of one dozen of eggs if 7 dozen cost 84 cents?

22. 75 bushels of wheat were produced on 5 acres of land. How many bushels did one acre produce?

23. A school-building of 8 rooms contains 240 desks. How many desks are in each room?

24. If 216 bars of soap were packed in 9 boxes, how many bars would one box hold?

25. Six men built 450 rods of fence. How many rods did each build?

26. If a certain number be multiplied by 7 the result will be 98. What is the number?

27. The product of two numbers is 156. If 12 is one of them, what is the other?

28. Paid 427 dollars for 7 horses. What was their average value?

29. A quantity of provisions will supply one person for 324 days. How long would it last 9 persons?

30. Five barrels of cider contained 165 gallons. How many gallons were in each barrel?

31. How many four-pound weights could be made from 320 pounds of iron?

32. Eight acres of timber-land yielded 256 cords of wood. How many cords did one acre produce?

33. If 343 be divided by a certain number, the quotient will be 7. What is the divisor?

34. An express train ran 270 miles in 6 hours. How far was that per hour?

35. Divide the quotient of 240 ÷ 5, by the quotient of 108 ÷ 9.

MULTIPLICATION AND DIVISION.

Lesson XIV.

1. 9 times 2 are how many times 3?

Solution: 9 times 2 are 18. 18 are as many times 3 as 3 are contained in 18, which is 6 times.

2. 6 times 8 are how many times 4? 12?

3. 3 times 12 are how many times 9? 4?

4. 10 times 6 are how many times 12? 2?

5. 12 times 6 are how many times 8? 9?
6. 8 times 5 are how many times 10? 2?
7. 6 times 9 are how many times 2? 3?
8. 9 times 4 are how many times 3? 6?
9. 7 times 12 are how many times 6? 4?
10. 10 times 8 are how many times 4? 5? 2?
11. 6 times 16 are how many times 3? 12? 8?
12. 4 times 25 are how many times 5? 10? 20?
13. 9 times 12 are how many times 6? 4? 3?
14. 12 times 4 are how many times 8? 6? 3?
15. 5 times 20 are how many times 10? 25? 50?
16. 10 times 12 are how many times 6? 8? 20?
17. 9 times 8 are how many times 4? 6? 12?
18. 8 times 12 are how many times 4? 6? 3?
19. 6 times 15 are how many times 3? 5? 10?
20. 12 times 11 are how many times 4? 6? 3?
21. 5 times 32 are how many times 4? 8? 10?
22. 6 times 25 are how many times 2? 15? 50?
23. 7 times 24 are how many times 3? 4? 6? 8?
24. 8 times 18 are how many times 6? 8? 9? 12?
25. 9 times 14 are how many times 2? 3? 6? 7?
26. 10 times 18 are how many times 4? 5? 6? 10?
27. 12 times 16 are how many times 4? 6? 8? 3?

LESSON XV.

Review.

1. If a quantity of provisions supply 12 persons for 6 weeks, how long would it supply 8 persons?

2. If 9 men can do a certain work in 10 days, how many could do the same in 3 days?

3. Exchanged 14 quarts of milk at 6 cents a quart for 7 dozen eggs. What were the eggs worth per dozen?

4. If a stage-coach travel 45 miles in 5 hours, how far will it go in 11 hours?

5. If 48 pennyweights of gold will make 8 rings, how many rings of the same size could be made from 90 pennyweights?

6. I gave 7 oranges for 63 apples. How many apples should I have given for 12 oranges?

7. Three men earned 30 dollars in a certain time. How many men would have earned 100 dollars in the same time?

8. If a certain sum of money produce 125 dollars interest in 5 years, how much interest should it produce in 7 years?

9. 150 bushels of wheat were harvested from 10 acres. How many bushels ought 8 acres to yield?

10. How many men can do in 6 days the same amount of work that would occupy 12 men 8 days?

11. 80 kegs of wine, each containing 4 gallons, were emptied into 10 barrels. How many gallons were in each barrel?

12. In how many days of 12 hours each can the same work be performed that requires 16 days of 9 hours each?

13. Mary's age is 21 years, and 4 times Mary's age equals 7 times Sarah's. How old is Sarah?

14. There are 192 grains in 8 pennyweights. How many grains are in 7 pennyweights?

15. 192 ounces make 12 pounds of sugar. How many pounds are in 160 ounces?

16. 180 rods of fence were built by 15 men in one week. How many men could have built 240 rods in the same time?

17. Seven hogsheads of molasses cost 196 dollars. At the same rate, how many hogsheads should cost 112 dollars?

18. A company of 9 men bought 6 tracts of land, each containing 24 acres. How many acres belonged to each man?

19. A divisor is 25 and the quotient is 7. If the divisor were 35, what would the quotient be?

20. If a man can walk 216 miles in 8 days, how far can he walk in 5 days?

21. How many times can a vessel holding 12 gallons be filled from 10 barrels, each holding 18 gallons?

22. 40 cabbages were planted in each of 9 rows. Had they been planted in 8 rows, how many would have been in each row?

23. 15 men completed a piece of work in 30 days. Had it been necessary to complete it in 10 days, how many men should have been employed?

24. Paid 220 dollars for cows, at 20 dollars apiece. If I sold them at 25 dollars apiece, how much did I receive for them?

25. A dividend is 480, and a divisor 12. If the quotient were divided by 2, what would the divisor be?

26. An express train made a trip in 8 hours, at the rate of 45 miles an hour. What distance per hour should it have run to make the trip in 10 hours?

27. A trader sold 24 hogs at 9 dollars apiece, and spent the money for sheep, at 6 dollars each. How many sheep did he buy?

28. A farmer sold his hay for 360 dollars, at 12 dollars a ton. If he had sold it at 15 dollars a ton, how much would he have received?

29. A bolt of cloth was made into 5 suits, each containing 7 yards, and the lot was sold for 140 dollars. At what price per yard was it sold?

30. 480 pounds of beef were consumed by 24 men in 10 days. What was the daily allowance of each man?

LESSON XVI.

1. Which will cost the more, and how much more—18 tons of straw, at 4 dollars a ton, or 15 cords of wood, at 5 dollars a cord?

2. A and B are traveling on the same road, and in the same direction, A being 30 miles ahead, but B travels 8 miles an hour, and A only 5 miles. In how many hours will B overtake him?

3. In the above question, if they had traveled in opposite directions, how far apart would they have been at the end of 10 hours?

4. A clerk's salary is 15 dollars a week, and his expenses 7 dollars a week? How much will he save in 12 weeks?

5. If an apple is worth 12 plums, and 1 orange is worth 5 apples, how many plums should be given for 5 oranges?

6. Two men bought a horse for 80 dollars. After paying 20 dollars for his board, and receiving 40 dollars for his use, they sold him for 100 dollars. How much money did each gain?

7. Robert had 36 marbles, and Henry had 45. Each gave one-third of his marbles to the other. How many had each then?

8. If 15 barrels of flour are worth 75 dollars, and 18 barrels are given for 9 tons of hay, what is the hay worth per ton?

9. How many dozen eggs, at 16 cents a dozen, should be exchanged for 4 pecks of beans, each containing 8 quarts, at 5 cents a quart?

10. 9 rows of sweet potatoes were planted, with 20 hills to each row. Had the same number of hills been planted in 12 rows, how many hills would have been in each row?

11. Sold 12 barrels of pears for 42 dollars, thereby losing 6 dollars. For how much per barrel should they have been sold to gain 12 dollars?

12. A hogshead of molasses contained 63 gallons. A part was drawn off, and sold for 50 cents a gallon. If 350 cents were received for it, how many gallons remained unsold?

13. Paid 96 dollars for flour at 4 dollars a barrel. Sold 8 barrels at 6 dollars a barrel, and the remainder at 5 dollars a barrel. Find my gain.

14. The product of three numbers is 180. Two of them are 4 and 5. What is the third?

15. The sum of two numbers is 28. If 19 is one of them, what is their product?

16. The difference of two numbers is 15. If 5 is the less number, what is 10 times their sum?

17. The quotient of two numbers is 9. If 45 is one of them, what is their difference?

18. A lady bought an equal number of oranges and apples for 108 cents. If she paid 3 cents for an apple, and 6 cents for an orange, how many of each did she receive?

19. A cistern will hold 360 barrels of water. If it receives 36 barrels an hour by one pipe, and discharges 21 barrels an hour by another, in what time will it be filled?

20. If a certain number be divided by 8, the quotient will be 13, with a remainder of 7. What is the number?

21. If a certain number be multiplied by 6, the product will be 16 less than 166. What is the number?

22. Sold 12 cows for 150 dollars, thereby losing 30 dollars. For how much per head should I have sold them to gain 60 dollars?

23. Sold 8 acres of land for 400 dollars, thereby gaining 80 dollars. Had I sold the land for 300 dollars, how much would I have lost?

24. Two men are 144 miles apart, and travel toward each other, one going 5 miles an hour, the other 4 miles. In how many hours will they meet?

25. 25 men have provisions for 12 days. How many men could consume the provisions in 15 days?

26. A man walked 140 miles in 4 days. At that rate how far could he walk in 12 days?

27. A merchant sold a certain number of barrels of flour for 150 dollars, thereby gaining 25 dollars. If he received 6 dollars a barrel, what was the cost per barrel?

28. If 25 sheep cost 125 dollars, for how much per head must they be sold to gain 75 dollars?

29. If 20 hogs cost 120 dollars, for how much must they be sold to gain 2 dollars per head?

30. Paid 180 dollars for hay, at 12 dollars a ton, and sold it at 10 dollars a ton. Find my loss.

31. Sold 16 cords of wood for 100 dollars, thereby gaining 20 dollars. If I had sold it for 4 dollars a cord, how much would I have lost?

32. Paid 240 dollars for cows, at 15 dollars each, but 4 having died, at what price per head must I sell the remainder to sustain no loss?

33. A can husk 9 bushels of corn while B husks 12 bushels. When A has husked 108 bushels, how many has B husked?

34. A man can earn 25 cents in an hour, and his son 15 cents. How much will they together have earned when the boy has earned 150 cents?

35. Two men built a wall for 200 dollars. One worked 30 days, and received 3 dollars a day. The other received 2 dollars a day. How many days did he work?

36. 8 men were employed to do a piece of work in 15 days, but 2 of them failed to come. How long were the others employed?

37. Sold 6 horses at 50 dollars each, and then borrowed enough money to enable me to buy 5 lots at 80 dollars apiece. How much did I borrow?

38. Having paid 500 dollars for 20 acres of prairie land, I sold part of it for 360 dollars, thereby gaining 60 dollars. How many acres did I sell?

39. A has 18 sheep. B has twice as many, less 4. C has as many as A and B together. How many sheep have all?

40. A girl is 15 years old, which is 12 years less than the age of her brother. Her father is 32 years older than her brother, and her mother is 7 years younger than the father. How old are the brother, father, and mother?

PRINCIPLES.

To Teachers.

Much difficulty has heretofore arisen in regard to the proper understanding and interpretation of the use of the signs +, —, ×, and ÷; and, until recently, standard authorities have differed in respect to their meaning when employed in the statement of abstract problems. The ambiguity attendant upon the solution of certain problems involving the use of the signs × and ÷, in connection with the other signs, has led some authors to omit all such problems from their works. It is true, however, that in the primary grades it is almost impossible to impress their real meaning upon the minds of the pupils, and it is therefore not considered wise to undertake it. But as the student progresses, it is evident that the time *must come* when a thorough knowledge of the meaning of all the signs is imperatively necessary; and it is the author's belief that the proper time has arrived when the student has advanced to the present chapter. It is with this view that a list of drill questions involving the signs has been prepared.

$+$ and $-$ are called the *principal* signs. They indicate that the quantities between which they are placed are to be considered as single terms. Thus, $12+9\times2=30$, *not* 42; and $27-12\div3=23$, *not* 5. Similarly, $18+24\div2\times3=22$; and $50-8\times6\div2=26$. That is, the part of the term on the *left* of the sign of division is the *dividend*, and the part on the *right* is the divisor. By insisting upon the observance of these very simple rules, all uncertainty is overcome, the difficulties vanish, and the student will be better prepared to surmount many of the obstacles found in the higher mathematics.

LESSON XVII.

Use of the Signs.

1. $8+2\times8=$ what? $15-4\times2=$ what?
2. $25+15\div5=$ what? $42-18\div3=$ what?
3. $32+24\div2\times4=?$ $56-42\div7\times3=?$
4. $48-6\times12\div4=?$ $63+15\times3\div9=?$
5. $75-12\times5\div6=?$ $81+16\times6\div8=?$
6. $96\div6\times4-3=?$ $100\div4\times5+6=?$
7. $12+5\times8-7\times2=?$ $78-56\div7+6\times5=?$
8. $12+8\times12-8=?$ $100-7\times9+60\div4\times3=?$
9. $10\times15\div3+48\div2\times4=?$ $108\div6\times2-18\div2\times3=?$
10. $125-8\times7\div4+72\div2\times4=?$ $40+13\times4-120\div3\times5=?$
11. $15\times64\div16+36-42\div7\times2+72\div6\times3-12\times10\div6=?$
12. $100\div2\times5+18\times5\div3\times6-4\times21\div7+9\times8\div3-2=?$

Section II.

FACTORING.

Lesson I.

Principles.

An *integer* is a whole number, as 3, 25, 100.

A *factor* (or divisor) of a number will exactly divide that number. Thus, 4 is a factor of 20.

A *multiple* (or product) of a number will exactly contain that number. Thus, 20 is a multiple of 4.

Integers are divided into two classes, *prime numbers* and *composite numbers.*

A *prime number* has no factors besides itself and 1. The prime numbers between 1 and 100 are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

A *composite number* has other factors besides itself and 1. Thus, 24 is a composite number, having the factors 2, 3, 4, 6, 8, 12.

A *common factor* of two or more numbers will exactly divide all of them. Thus, 3 is a common factor of 6, 9, 12, etc.

A *common multiple* of two or more numbers will exactly contain all of them. Thus, 30 is a common multiple *of 6, 10, and 15.*

Numbers are prime to each other when they contain no common factor. Thus, 4 and 5 and 7 and 9 are severally prime to each other.

Composite numbers are divisible by the product of any two or more of their prime factors. Thus, 2, 3, and 5 are the prime factors of 30, and 30 is divisible by 2 × 3, 2 × 5, and 3 × 5.

The *greatest common divisor* (G. C. D.) of two or more numbers is the *greatest number* that will exactly divide all of them. Thus, 6 is the G. C. D. of 12, 18, and 30.

The *least common multiple* (L. C. M.) of two or more numbers is the least number that will exactly contain all of them. Thus, 48 is the L. C. M. of 8, 12, and 16.

Any number is divisible by 2 if it ends with 0, or 2, 4, 6, or 8.

Any number is divisible by 3 if the sum of its digits is divisible by 3. Thus, 357 is divisible by 3, because $3 + 5 + 7$, or 15, is divisible by 3.

Any number is divisible by 4 if the number denoted by its last two digits is divisible by 4. Thus, 532 is divisible by 4, because 32 is divisible by 4.

Any number is divisible by 5 if its last digit is either 0 or 5. Thus, 95 and 140 are divisible by 5.

Any number is divisible by 8 if the number denoted by its last 3 digits is divisible by 8. Thus, 4112 is divisible by 8, because 112 is divisible by 8.

Any number is divisible by 9 if the sum of its digits is divisible by 9. Thus, 2574 is divisible by 9, because $2 + 5 + 7 + 4$, or 18, is divisible by 9.

LESSON II.

Find the G. C. D. of

1. 4, 10; 6, 9; 8, 12; 10, 15; 9, 21.
2. 6, 15; 10, 14; 12, 18; 12, 20; 14, 21.
3. 3, 24; 4, 24; 6, 24; 8, 24; 12, 24.
4. 18, 24; 16, 24; 10, 24; 15, 24; 20, 24.
5. 21, 35; 18, 45; 32, 56; 24, 60; 32, 48.
6. 33, 55; 26, 65; 34, 85; 38, 57; 39, 91.
7. 35, 63; 32, 72; 36, 84; 45, 75; 36, 90.
8. 28, 70; 45, 72; 54, 99; 57, 95; 46, 115.
9. 42, 105; 26, 78; 48, 80; 56, 84; 55, 99.
10. 54, 90; 68, 102; 38, 95; 42, 112; 63, 105.
11. 52, 91; 40, 96; 78, 117; 76, 133; 84, 146.
12. 68, 119; 28, 98; 74, 111; 69, 115; 76, 114.
13. 96, 128; 108, 144; 75, 105; 87, 116; 62, 155.

LESSON III.

To find the L. C. M. of two numbers, divide them by their G. C. D. Then multiply together the G. C. D. and the quotients.

Find the L. C. M. of

1. 8, 12; 6, 9; 9, 12: 12, 18; 15, 25.
2. 14, 21; 16, 24; 18, 24; 20, 25; 18, 30.
3. 10, 15; 21, 28; 32, 48; 15, 40; 24, 60.
4. 32, 80; 28, 42; 16, 36; 28, 70; 24, 32.
5. 14, 35; 27, 36; 36, 60; 18, 45; 42, 63.
6. 29, 87; 16, 56; 15, 36; 21, 56; 48, 64.
7. 20, 35; 30, 45; 36, 45; 27, 63; 42, 56.
8. 64, 96; 24, 36; 16, 72; 20, 45; 28, 35.
9. 60, 90; 56, 70; 39, 117; 48, 120; 27, 45.

10. 12, 15, 20; 14, 21, 28; 15, 20, 24.
11. 16, 18, 24; 20, 30, 40; 12, 18, 27.
12. 14, 16, 28; 8, 12, 20; 16, 20, 32.
13. 15, 25, 30; 8, 12, 32; 20, 28, 70.
14. 12, 33, 44; 19, 57, 171; 39, 52, 156.

NOTE.—*To find the L. C. M. of three numbers, find the L. C. M. of two of them, then of that L. C. M. and the third number.*

EXAMPLE.—Find the L. C. M. of 12, 18, 27.
Solution: The L. C. M. of 12 and 18 is 36. The L. C. M. of 36 and 27 is 108. *Answer:* 108.

FRACTIONS.

LESSON I.

A *unit* is a single thing of any kind, and can be divided into equal parts.

A *fraction* is an expression used to denote one or more equal parts of a unit.

Fractions are divided into two classes, *common* and *decimal.*

A *common* fraction is expressed by two numbers, one below the other, with a short line between them. Thus, one-third is written $\frac{1}{3}$; four-fifths are written $\frac{4}{5}$; five-sevenths are written $\frac{5}{7}$, etc.

The number below the line is called the *denominator.* It represents the number of equal parts into which a unit has been divided.

The number above the line is called the *numerator.* It represents the number of parts to be taken. Thus, the fraction $\frac{3}{4}$ shows that a unit has been divided into 4 equal parts, and that 3 of the parts have been taken.

The numerator and denominator are called the *terms* of the fraction.

A *proper fraction* is one whose *value is less than one.* Thus, the fraction $\frac{3}{5}$ shows that a unit has been divided into *five* equal parts, and that but *three* of the parts have been taken. In every *proper* fraction, the numerator is smaller than the denominator.

An *improper fraction* is one whose value is *equal to one*, or *greater than one.* Thus, $\frac{5}{5}$ and $\frac{7}{6}$ are improper fractions, the value of the first being *equal* to one, and the value of the second *greater* than one.

A *mixed number* is a whole number with a fraction annexed. Thus, $3\frac{4}{7}$ is a mixed number, and is read *three and four-sevenths.*.

A *compound fraction* is a fraction of a fraction, as, $\frac{4}{5}$ of $\frac{3}{7}$, or $\frac{4}{5}$ *multiplied by* $\frac{3}{7}$. The sign of multiplication is frequently used instead of the word "of," to indicate multiplication of fractions, as, $\frac{2}{3} \times \frac{4}{5} \times \frac{3}{8}$.

LESSON II.

If an apple is divided into *two* equal parts, what is one part called? *Answer:* One of the parts is called *one-half.*

If an apple is divided into *three* equal parts, what is one part called? Two of the parts? Three of the parts?

Answer: One of the parts is called *one-third.* Two of the parts are called *two-thirds.* Three of the parts are called *three-thirds*, or the *whole.*

1. How many halves in 1 apple? in 2? in 3? in 4? in 5? in 6?

2. How many thirds in 1 unit? in 2? in 3? in 4? in 5? in 6?

3. How many fourths in 1 unit? in 2? in 3? in 4? in 5? in 6?

4. How many fifths in 1 unit? in 2? in 3? in 4? in 5? in 6?

5. How many sixths in 1 unit? in 2? in 3? in 4? in 5? in 6?

6. How many sevenths in 1 unit? in 2? in 3? in 4? in 5? in 6?

7. How many eighths in 1 unit? in 2? in 3? in 4? in 5? in 6?

8. How many ninths in 1 unit? in 2? in 3? in 4? in 5? in 6?

9. How many tenths in 1 unit? in 2? in 3? in 4? in 5? in 6?

10. How many elevenths in 1 unit? in 2? in 3? in 4? in 5? in 6?

11. How many twelfths in 1 unit? in 2? in 3? in 4? in 5? in 6?

Write the following fractions:

Three-fifths, five-sixths, four-sevenths, five-eighths, seven-ninths, three-tenths, eight-elevenths, seven-twelfths, nine-thirteenths, eleven-fourteenths, thirteen-fifteenths, seven-sixteenths, eight-seventeenths, eleven-eighteenths, sixteen-nineteenths, seventeen-twentieths, twenty-three twenty-fifths, twenty-four thirty-sevenths, thirty-nine forty-sixths, forty-eight forty-ninths, twenty-one fiftieths, fifty-seven sixty-fourths, thirteen seventy-fifths, sixty-four eighty-ninths, seventy-five ninety-eighths, ninety-nine one-hundredths, forty-nine one hundred and twenty-fifths.

Read the following:

$\frac{8}{4}$, $\frac{5}{7}$, $\frac{7}{8}$, $\frac{5}{12}$, $\frac{11}{15}$, $\frac{13}{17}$, $\frac{19}{22}$, $\frac{21}{25}$, $\frac{17}{33}$, $\frac{29}{37}$, $\frac{31}{41}$, $\frac{47}{50}$, $\frac{18}{55}$, $\frac{25}{63}$, $\frac{48}{67}$, $\frac{71}{75}$, $\frac{56}{79}$, $\frac{83}{86}$, $\frac{87}{88}$, $\frac{39}{97}$, $\frac{99}{100}$.

$\frac{9}{8}$, $\frac{11}{7}$, $\frac{13}{10}$, $\frac{17}{6}$, $\frac{19}{15}$, $\frac{25}{17}$, $\frac{31}{25}$, $\frac{38}{27}$, $\frac{43}{39}$, $\frac{44}{41}$, $\frac{56}{47}$, $\frac{64}{55}$, $\frac{75}{68}$, $\frac{81}{79}$, $\frac{93}{83}$, $\frac{101}{99}$, $\frac{125}{116}$, $\frac{131}{125}$, $\frac{141}{140}$, $\frac{153}{149}$, $\frac{160}{157}$.

$5\frac{1}{3}$, $6\frac{3}{4}$, $7\frac{1}{2}$, $8\frac{7}{8}$, $10\frac{4}{9}$, $13\frac{7}{12}$, $15\frac{15}{16}$, $17\frac{8}{11}$, $19\frac{16}{25}$, $27\frac{18}{88}$, $48\frac{12}{35}$, $50\frac{49}{50}$, $69\frac{17}{18}$, $76\frac{38}{75}$, $99\frac{99}{100}$.

Reduce the following to whole or mixed numbers:

$\frac{16}{8}$, $\frac{15}{8}$, $\frac{19}{5}$, $\frac{21}{4}$, $\frac{33}{7}$, $\frac{49}{9}$, $\frac{59}{10}$, $\frac{64}{8}$, $\frac{72}{11}$, $\frac{85}{7}$, $\frac{94}{9}$, $\frac{101}{8}$, $\frac{115}{11}$, $\frac{116}{9}$, $\frac{127}{10}$, $\frac{129}{11}$, $\frac{132}{12}$, $\frac{143}{12}$.

Reduce the following to improper fractions:

$1\frac{1}{2}$, $2\frac{2}{3}$, $3\frac{3}{4}$, $4\frac{4}{5}$, $5\frac{5}{6}$, $6\frac{6}{7}$, $7\frac{7}{8}$, $8\frac{8}{9}$, $9\frac{9}{10}$, $10\frac{10}{11}$, $11\frac{11}{12}$, $16\frac{2}{3}$, $18\frac{3}{4}$, $14\frac{2}{7}$, $19\frac{9}{10}$, $22\frac{2}{9}$.

LESSON III.

A fraction is in its *lowest terms* when its numerator and denominator contain no *common factor*.

A fraction is reduced to its lowest terms (1), by dividing both terms by any common factor, and the resulting fraction in the same manner, until no number greater than 1 will exactly divide both terms, or, (2), if both terms of a fraction be divided by their *G. C. D.* the resulting fraction will be in its lowest terms.

Reduce $\frac{30}{48}$ to its lowest terms.

Solution: (1) Dividing both terms by 2, the result is $\frac{15}{24}$, dividing both terms of $\frac{15}{24}$ by 3, the result is $\frac{5}{8}$, which is the answer;

Or: (2) Dividing both terms of $\frac{30}{48}$ by their G. C. D. (6), the result is $\frac{5}{8}$.

Reduce to their lowest terms

1. $\frac{4}{8}$, $\frac{4}{10}$, $\frac{9}{12}$, $\frac{6}{9}$, $\frac{5}{15}$, $\frac{8}{14}$, $\frac{10}{16}$, $\frac{14}{18}$, $\frac{18}{20}$.
2. $\frac{14}{21}$, $\frac{16}{22}$, $\frac{15}{24}$, $\frac{10}{25}$, $\frac{18}{26}$, $\frac{21}{28}$, $\frac{21}{30}$, $\frac{12}{32}$, $\frac{14}{34}$.
3. $\frac{22}{33}$, $\frac{26}{34}$, $\frac{20}{35}$, $\frac{20}{36}$, $\frac{24}{38}$, $\frac{26}{39}$, $\frac{25}{40}$, $\frac{28}{40}$, $\frac{30}{40}$.
4. $\frac{14}{42}$, $\frac{32}{44}$, $\frac{27}{45}$, $\frac{26}{46}$, $\frac{33}{48}$, $\frac{20}{48}$, $\frac{30}{48}$, $\frac{32}{48}$, $\frac{40}{48}$.
5. $\frac{21}{49}$, $\frac{35}{50}$, $\frac{34}{51}$, $\frac{16}{52}$, $\frac{18}{54}$, $\frac{33}{55}$, $\frac{35}{56}$, $\frac{48}{56}$, $\frac{38}{57}$.
6. $\frac{25}{60}$, $\frac{39}{60}$, $\frac{45}{60}$, $\frac{48}{60}$, $\frac{24}{64}$, $\frac{26}{65}$, $\frac{55}{66}$, $\frac{51}{68}$, $\frac{46}{69}$.
7. $\frac{21}{70}$, $\frac{56}{70}$, $\frac{16}{72}$, $\frac{24}{72}$, $\frac{45}{72}$, $\frac{10}{75}$, $\frac{24}{75}$, $\frac{35}{75}$, $\frac{50}{75}$.
8. $\frac{24}{76}$, $\frac{57}{76}$, $\frac{50}{78}$, $\frac{12}{80}$, $\frac{25}{80}$, $\frac{44}{80}$, $\frac{18}{81}$, $\frac{20}{84}$, $\frac{49}{84}$.
9. $\frac{45}{84}$, $\frac{72}{84}$, $\frac{34}{85}$, $\frac{29}{87}$, $\frac{66}{88}$, $\frac{42}{90}$, $\frac{27}{90}$, $\frac{36}{90}$, $\frac{55}{90}$.
10. $\frac{39}{91}$, $\frac{49}{91}$, $\frac{31}{93}$, $\frac{15}{95}$, $\frac{38}{95}$, $\frac{36}{96}$, $\frac{42}{96}$, $\frac{45}{96}$, $\frac{64}{96}$, $\frac{84}{96}$.
11. $\frac{24}{99}$, $\frac{55}{99}$, $\frac{2}{100}$, $\frac{8}{100}$, $\frac{15}{100}$, $\frac{30}{100}$, $\frac{40}{100}$, $\frac{75}{100}$, $\frac{24}{108}$, $\frac{30}{108}$.
12. $\frac{16}{108}$, $\frac{75}{108}$, $\frac{81}{108}$, $\frac{16}{120}$, $\frac{84}{120}$, $\frac{55}{120}$, $\frac{42}{120}$, $\frac{48}{120}$, $\frac{39}{120}$.

LESSON IV.

Reduction to higher terms.

1. Reduce $\frac{1}{2}$ to eighths.

Solution: In 1 there are 8 *eighths*, and in $\frac{1}{2}$ there is $\frac{1}{2}$ of 8 *eighths*, which is 4 *eighths*. *Answer:* 4 *eighths*.

2. Reduce $\frac{1}{3}$ to ninths; $\frac{1}{4}$ to twelfths; $\frac{1}{5}$ to tenths.

3. Reduce $\frac{1}{6}$ to twelfths; $\frac{1}{3}$ to fifteenths; $\frac{1}{4}$ to sixteenths.

4. Reduce $\frac{1}{4}$ to twentieths; $\frac{1}{5}$ to twentieths; $\frac{1}{10}$ to twentieths.

5. Reduce $\frac{5}{6}$ to twelfths.

Solution: In 1 there are $\frac{12}{12}$. In $\frac{1}{6}$ there are $\frac{2}{12}$. And in $\frac{5}{6}$ there are $\frac{10}{12}$.

6. Reduce $\frac{5}{7}$ to fourteenths; $\frac{5}{8}$ to sixteenths; $\frac{4}{9}$ to eighteenths.

7. Reduce $\frac{7}{12}$ to twenty-fourths; $\frac{7}{8}$ to twenty-fourths.

8. Reduce $\frac{3}{5}$ to twenty-fifths; $\frac{4}{7}$ to twenty-eighths.

9. Reduce $\frac{5}{6}$ to thirtieths; $\frac{3}{7}$ to thirty-fifths.

10. Reduce $\frac{7}{12}$ to thirty-sixths; $\frac{11}{13}$ to thirty-ninths.

11. Reduce $\frac{5}{8}$ to fortieths; $\frac{7}{10}$ to fortieths; $\frac{13}{20}$ to fortieths.

12. Reduce $\frac{8}{11}$ to forty-fourths; $\frac{7}{15}$ to forty-fifths.

13. Reduce $\frac{5}{9}$ to forty-fifths; $\frac{11}{12}$ to forty-eighths.

14. Reduce $\frac{3}{8}$ to forty-eighths; $\frac{9}{16}$ to forty-eighths.

15. Reduce $\frac{2}{5}$ to fiftieths; $\frac{7}{10}$ to fiftieths; $\frac{16}{25}$ to fiftieths.

16. Reduce $\frac{4}{9}$ to fifty-fourths; $\frac{11}{18}$ to fifty-fourths.

17. Reduce $\frac{5}{6}$ to sixtieths; $\frac{7}{12}$ to sixtieths; $\frac{8}{15}$ to sixtieths.

18. Reduce $\frac{3}{8}$ to sixty-fourths; $\frac{9}{16}$ to sixty-fourths.

19. Reduce $\frac{3}{5}$ to seventieths; $\frac{9}{14}$ to seventieths.

20. Reduce $\frac{4}{15}$ to seventy-fifths; $\frac{8}{25}$ to seventy-fifths.

21. Reduce $\frac{5}{8}$ to eightieths; $\frac{7}{16}$ to eightieths; $\frac{11}{20}$ to eightieths.

22. Reduce $\frac{5}{12}$ to eighty-fourths; $\frac{9}{14}$ to eighty-fourths.

23. Reduce $\frac{3}{5}$ to ninetieths; $\frac{7}{18}$ to ninetieths; $\frac{13}{30}$ to ninetieths.

24. Reduce $\frac{3}{4}$ to hundredths; $\frac{16}{25}$ to hundredths; $\frac{33}{50}$ to hundredths.

LESSON V.

It is frequently necessary to reduce two or more fractions of *different* denominators to other fractions having a common denominator. This is done by finding the product of their denominators, or by finding their *least common multiple.* The object of reducing fractions to a common denominator is to prepare them for addition or subtraction.

Reduce $\frac{2}{3}$ and $\frac{3}{5}$ to equivalent fractions having a common denominator.

Solution: The common denominator is 15. $\frac{2}{3}=\frac{10}{15}$, $\frac{3}{5}=\frac{9}{15}$.

NOTE.—*If there are but two fractions, the shortest method is to multiply the numerator of each fraction by the denominator of the other.*

Reduce to equivalent fractions having a common denominator:

1. $\frac{1}{3}$ and $\frac{1}{4}$; $\frac{1}{2}$ and $\frac{1}{5}$; $\frac{1}{3}$ and $\frac{1}{5}$; $\frac{1}{2}$ and $\frac{1}{7}$; $\frac{1}{3}$ and $\frac{1}{7}$.
2. $\frac{2}{3}$ and $\frac{3}{4}$; $\frac{2}{3}$ and $\frac{3}{5}$; $\frac{2}{3}$ and $\frac{3}{7}$; $\frac{2}{3}$ and $\frac{3}{8}$; $\frac{2}{3}$ and $\frac{3}{10}$.
3. $\frac{3}{4}$ and $\frac{4}{5}$; $\frac{3}{4}$ and $\frac{4}{7}$; $\frac{3}{4}$ and $\frac{4}{9}$; $\frac{3}{4}$ and $\frac{4}{11}$; $\frac{3}{4}$ and $\frac{4}{13}$.
4. $\frac{4}{5}$ and $\frac{5}{6}$; $\frac{4}{5}$ and $\frac{5}{7}$; $\frac{4}{5}$ and $\frac{5}{8}$; $\frac{4}{5}$ and $\frac{5}{9}$; $\frac{4}{5}$ and $\frac{5}{12}$.
5. $\frac{5}{6}$ and $\frac{5}{7}$; $\frac{5}{6}$ and $\frac{5}{11}$; $\frac{4}{7}$ and $\frac{5}{8}$; $\frac{4}{7}$ and $\frac{5}{9}$; $\frac{4}{7}$ and $\frac{7}{10}$.
6. $\frac{7}{9}$ and $\frac{7}{10}$; $\frac{2}{3}$ and $\frac{9}{10}$; $\frac{5}{8}$ and $\frac{5}{9}$; $\frac{7}{8}$ and $\frac{10}{11}$; $\frac{8}{9}$ and $\frac{9}{11}$.
7. $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{5}$; $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$; $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{7}$; $\frac{1}{2}$, $\frac{2}{5}$, and $\frac{4}{7}$.
8. $\frac{1}{3}$, $\frac{3}{5}$, and $\frac{5}{7}$; $\frac{1}{2}$, $\frac{2}{5}$, and $\frac{4}{9}$; $\frac{2}{3}$, $\frac{4}{5}$, and $\frac{5}{8}$; $\frac{3}{4}$, $\frac{3}{5}$, and $\frac{3}{7}$.
9. $\frac{2}{3}$, $\frac{3}{5}$, and $\frac{7}{8}$; $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{9}$; $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{4}{7}$; $\frac{1}{2}$, $\frac{2}{7}$, and $\frac{4}{9}$.
10. $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{9}$; $\frac{2}{3}$, $\frac{4}{7}$, and $\frac{7}{8}$; $\frac{1}{2}$, $\frac{2}{5}$, and $\frac{7}{9}$; $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{13}$.

NOTE.—*Beginning with the seventh above, it is best to multiply both terms of each fraction by the product of all the denominators except its own.*

LESSON VI.

Reduce to equivalent fractions having a least common denominator:

1. $\frac{5}{6}$ and $\frac{5}{9}$.

Solution: The least common denominator is 18. $\frac{5}{6}$ are $\frac{15}{18}$, and $\frac{5}{9}$ are $\frac{10}{18}$. *Answer:* $\frac{15}{18}$ and $\frac{10}{18}$.

2. $\frac{3}{8}$ and $\frac{7}{12}$; $\frac{3}{4}$ and $\frac{3}{10}$; $\frac{7}{10}$ and $\frac{4}{15}$; $\frac{5}{9}$ and $\frac{11}{12}$.
3. $\frac{5}{8}$ and $\frac{9}{10}$; $\frac{3}{14}$ and $\frac{10}{21}$; $\frac{4}{9}$ and $\frac{8}{15}$; $\frac{7}{12}$ and $\frac{9}{16}$.
4. $\frac{7}{10}$ and $\frac{8}{25}$; $\frac{11}{18}$ and $\frac{10}{27}$; $\frac{5}{8}$ and $\frac{9}{14}$; $\frac{9}{10}$ and $\frac{4}{15}$.
5. $\frac{4}{9}$ and $\frac{8}{21}$; $\frac{7}{10}$ and $\frac{3}{14}$; $\frac{4}{9}$ and $\frac{5}{12}$; $\frac{3}{8}$ and $\frac{11}{18}$.
6. $\frac{4}{15}$ and $\frac{6}{25}$; $\frac{9}{10}$ and $\frac{11}{16}$; $\frac{5}{12}$ and $\frac{3}{14}$; $\frac{5}{14}$ and $\frac{10}{21}$.

7. $\frac{3}{8}$ and $\frac{7}{22}$; $\frac{7}{10}$ and $\frac{11}{18}$; $\frac{5}{24}$ and $\frac{11}{32}$; $\frac{7}{20}$ and $\frac{8}{25}$.
8. $\frac{2}{3}$, $\frac{5}{8}$, and $\frac{7}{12}$; $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{9}{10}$; $\frac{5}{6}$, $\frac{9}{10}$, and $\frac{8}{15}$.
9. $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{11}{18}$; $\frac{4}{9}$, $\frac{5}{6}$, and $\frac{11}{12}$; $\frac{5}{6}$, $\frac{9}{14}$, and $\frac{8}{21}$.
10. $\frac{3}{5}$, $\frac{3}{8}$, and $\frac{3}{10}$; $\frac{5}{6}$, $\frac{7}{12}$, and $\frac{9}{16}$; $\frac{3}{8}$, $\frac{11}{14}$, and $\frac{9}{28}$.
11. $\frac{5}{12}$, $\frac{8}{15}$, and $\frac{13}{20}$; $\frac{7}{8}$, $\frac{11}{12}$, and $\frac{13}{18}$; $\frac{2}{5}$, $\frac{7}{15}$, and $\frac{9}{25}$.
12. $\frac{3}{8}$, $\frac{9}{16}$, and $\frac{11}{20}$; $\frac{9}{14}$, $\frac{10}{21}$, and $\frac{13}{28}$; $\frac{7}{10}$, $\frac{4}{15}$, and $\frac{5}{18}$.
13. $\frac{5}{12}$, $\frac{7}{32}$, and $\frac{11}{48}$; $\frac{3}{20}$, $\frac{6}{25}$, and $\frac{9}{50}$; $\frac{11}{12}$, $\frac{5}{18}$, and $\frac{10}{27}$.
14. $\frac{7}{8}$, $\frac{9}{14}$, and $\frac{5}{16}$; $\frac{3}{8}$, $\frac{7}{10}$, and $\frac{11}{12}$; $\frac{8}{15}$, $\frac{9}{20}$, and $\frac{7}{24}$.
15. $\frac{3}{8}$, $\frac{7}{12}$, and $\frac{13}{30}$; $\frac{9}{16}$, $\frac{11}{18}$, and $\frac{5}{24}$; $\frac{7}{10}$, $\frac{8}{15}$ and $\frac{16}{25}$.
16. $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, and $\frac{11}{12}$; $\frac{4}{5}$, $\frac{5}{6}$, $\frac{7}{10}$, and $\frac{8}{15}$.
17. $\frac{3}{8}$, $\frac{5}{12}$, $\frac{9}{16}$, and $\frac{13}{24}$; $\frac{2}{3}$, $\frac{7}{12}$, $\frac{4}{15}$, and $\frac{9}{20}$.
18. $\frac{5}{8}$, $\frac{4}{9}$, $\frac{5}{12}$, and $\frac{7}{18}$; $\frac{11}{12}$, $\frac{11}{16}$, $\frac{11}{24}$, and $\frac{11}{32}$.
19. $\frac{3}{4}$, $\frac{7}{10}$, $\frac{9}{20}$, and $\frac{12}{25}$; $\frac{5}{8}$, $\frac{7}{12}$, $\frac{13}{18}$, and $\frac{16}{27}$.
20. $\frac{7}{8}$, $\frac{9}{10}$, $\frac{11}{12}$, $\frac{14}{15}$, $\frac{19}{20}$, $\frac{23}{24}$, and $\frac{29}{30}$.
21. $\frac{3}{8}$, $\frac{4}{9}$, $\frac{5}{12}$, $\frac{7}{16}$, $\frac{11}{18}$, $\frac{13}{24}$, $\frac{15}{36}$, $\frac{17}{48}$, and $\frac{19}{72}$.
22. $\frac{2}{5}$, $\frac{5}{6}$, $\frac{7}{10}$, $\frac{8}{15}$, $\frac{9}{25}$, $\frac{11}{30}$, $\frac{13}{50}$, and $\frac{14}{75}$.

LESSON VII.

1. How many halves are in $3\frac{1}{2}$?

Solution: In 1 there are two halves; in 3 there are six halves; and the sum of six halves and one half is seven halves. *Answer:* Seven halves.

2. How many halves in $7\frac{1}{2}$? $8\frac{1}{2}$? $9\frac{1}{2}$? $10\frac{1}{2}$? $12\frac{1}{2}$?
3. How many thirds in $3\frac{1}{3}$? $6\frac{2}{3}$? $8\frac{1}{3}$? $13\frac{1}{3}$? $16\frac{2}{3}$?
4. How many fourths in $6\frac{1}{4}$? $8\frac{3}{4}$? $9\frac{1}{4}$? $18\frac{3}{4}$? $31\frac{1}{4}$?
5. How many fifths in $5\frac{1}{5}$? $6\frac{2}{5}$? $9\frac{3}{5}$? $10\frac{4}{5}$? $19\frac{4}{5}$?
6. How many sixths in $3\frac{1}{6}$? $5\frac{5}{6}$? $8\frac{1}{6}$? $10\frac{5}{6}$? $11\frac{1}{6}$?
7. How many sevenths in $4\frac{1}{7}$? $6\frac{2}{7}$? $8\frac{3}{7}$? $9\frac{4}{7}$? $12\frac{6}{7}$?
8. How many eighths in $5\frac{1}{8}$? $7\frac{3}{8}$? $9\frac{5}{8}$? $11\frac{7}{8}$? $12\frac{3}{8}$?
9. How many ninths in $6\frac{1}{9}$? $7\frac{2}{9}$? $8\frac{4}{9}$? $10\frac{5}{9}$? $11\frac{1}{9}$?
10. How many tenths in $7\frac{1}{10}$? $8\frac{3}{10}$? $9\frac{5}{10}$? $10\frac{7}{10}$? $12\frac{9}{10}$?

11. How many elevenths in $8\frac{1}{11}$? $9\frac{3}{11}$? $10\frac{4}{11}$? $11\frac{5}{11}$? $12\frac{10}{11}$?

12. How many twelfths in $8\frac{1}{12}$? $9\frac{5}{12}$? $10\frac{7}{12}$? $11\frac{11}{12}$? $12\frac{12}{12}$?

LESSON VIII.

1. What are $\frac{5}{6}$ of 12?

Solution: $\frac{1}{6}$ of 12 is 2, and $\frac{5}{6}$ of 12 are 5 times 2, which are 10. *Answer:* 10.

2. What are $\frac{3}{4}$ of 8? $\frac{2}{5}$ of 10? $\frac{3}{4}$ of 12? $\frac{5}{7}$ of 14?
3. What are $\frac{3}{8}$ of 16? $\frac{5}{9}$ of 18? $\frac{3}{5}$ of 20? $\frac{5}{6}$ of 24?
4. What are $\frac{4}{5}$ of 25? $\frac{2}{9}$ of 27? $\frac{5}{6}$ of 30? $\frac{7}{10}$ of 30?
5. What are $\frac{8}{11}$ of 33? $\frac{3}{5}$ of 35? $\frac{2}{9}$ of 36? $\frac{5}{12}$ of 36?
6. What are $\frac{2}{3}$ of 39? $\frac{3}{5}$ of 40? $\frac{5}{8}$ of 40? $\frac{9}{10}$ of 40?
7. What are $\frac{2}{3}$ of 42? $\frac{5}{6}$ of 42? $\frac{4}{7}$ of 42? $\frac{9}{14}$ of 42?
8. What are $\frac{2}{3}$ of 45? $\frac{3}{5}$ of 45? $\frac{4}{9}$ of 45? $\frac{7}{15}$ of 45?
9. What are $\frac{5}{6}$ of 48? $\frac{3}{8}$ of 48? $\frac{7}{12}$ of 48? $\frac{9}{16}$ of 48?
10. What is $\frac{1}{2}$ of 50? $\frac{2}{5}$ of 50? $\frac{3}{10}$ of 50? $\frac{12}{25}$ of 50?
11. What are $\frac{5}{6}$ of 60? $\frac{7}{10}$ of 60? $\frac{11}{12}$ of 60? $\frac{13}{15}$ of 60?
12. What are $\frac{2}{5}$ of 70? $\frac{4}{7}$ of 70? $\frac{7}{10}$ of 70? $\frac{9}{14}$ of 70?
13. What are $\frac{2}{3}$ of 75? $\frac{3}{5}$ of 75? $\frac{11}{15}$ of 75? $\frac{12}{25}$ of 75?
14. What are $\frac{3}{8}$ of 80? $\frac{7}{10}$ of 80? $\frac{9}{16}$ of 80? $\frac{13}{20}$ of 80?
15. What are $\frac{2}{3}$ of 81? $\frac{4}{9}$ of 81? $\frac{13}{27}$ of 81? $\frac{2}{3}$ of 90?
16. What are $\frac{2}{5}$ of 90? $\frac{5}{6}$ of 90? $\frac{7}{15}$ of 90? $\frac{11}{18}$ of 90?
17. What are $\frac{3}{8}$ of 96? $\frac{7}{12}$ of 96? $\frac{9}{16}$ of 96? $\frac{11}{24}$ of 96?
18. What are $\frac{3}{10}$ of 100? $\frac{9}{20}$ of 100? $\frac{12}{25}$ of 100? $\frac{16}{25}$ of 100?

19. What are $\frac{4}{9}$ of 108? $\frac{5}{12}$ of 108? $\frac{7}{18}$ of 108? $\frac{14}{27}$ of 108?

20. What are $\frac{3}{7}$ of 112? $\frac{5}{8}$ of 112? $\frac{11}{14}$ of 112? $\frac{9}{16}$ of 112?

21. What are $\frac{3}{8}$ of 120? $\frac{7}{10}$ of 120? $\frac{7}{12}$ of 120? $\frac{8}{15}$ of 120?

22. What are $\frac{5}{6}$ of 126? $\frac{7}{9}$ of 126? $\frac{9}{14}$ of 126? $\frac{8}{21}$ of 126?

23. What are $\frac{3}{4}$ of 140? $\frac{7}{10}$ of 140? $\frac{11}{14}$ of 140? $\frac{15}{28}$ of 140?

24. What are $\frac{5}{8}$ of 144? $\frac{7}{9}$ of 144? $\frac{5}{12}$ of 144? $\frac{9}{16}$ of 144? $\frac{11}{18}$ of 144?

25. What are $\frac{5}{6}$ of 150? $\frac{7}{10}$ of 150? $\frac{8}{15}$ of 150? $\frac{16}{25}$ of 150? $\frac{37}{50}$ of 150?

26. If 3 quarts of cherries cost 15 cents, what will 1 quart cost?

Solution: If 3 quarts cost 15 cents, 1 quart will cost $\frac{1}{3}$ of 15 cents, which is 5 cents. *Answer:* 5 cents.

27. If 6 peaches are worth 42 plums, how many plums should be given for 1 peach?

28. Henry's age is 36 years, which is 4 times as great as John's age. How old is John?

29. A owns 63 acres of land, which is 7 times as much as B owns. How many acres does B own?

30. A farmer sold 120 bushels of wheat, which was 5 times as much as he kept. How many bushels did he keep?

31. A butcher paid 108 dollars for 9 hogs. What was each hog worth?

32. If a man can walk 28 miles in 7 hours, how far could he walk in 10 hours?

Solution: In 1 hour he could walk $\frac{1}{7}$ of 28 miles, or 4 miles, and in 10 hours he could walk 10 times 4 miles, or 40 miles. *Answer:* 40 miles.

33. A wagon wheel makes 8 revolutions in going 99 feet. How far would it go in making 12 revolutions?

34. If 10 pounds of coffee cost 150 cents, what would 6 pounds cost?

35. If 9 barrels of apples make 36 gallons of cider, how many gallons could be made from 11 barrels?

36. If 7 horses require 84 bushels of oats for a certain time, how many bushels would 12 horses require?

37. A laborer cut 88 cords of wood in 11 weeks. How many cords could he cut in 20 weeks?

38. A merchant paid 150 dollars for 25 barrels of flour. At the same rate, what should he pay for 30 barrels?

39. If 8 acres of land produce 120 bushels of wheat, how many bushels should 10 acres produce?

40. Twelve men built 132 rods of fence in a certain time. How many rods could 9 men have built in the same time?

41. If a quantity of oats last 8 horses 9 weeks, how long would it last 12 horses?

Solution: It would last 1 horse 8 times 9 weeks, or 72 weeks, and it would last 12 horses $\frac{1}{12}$ of 72 weeks, or 6 weeks. *Answer:* 6 weeks.

42. Exchanged 15 quarts of berries, at 8 cents a quart, for 10 dozen eggs. What was the value per dozen of the eggs?

43. 32 packages of starch, each weighing 5 pounds, were placed in 4 boxes. How many pounds were in each box?

44. 45 sheep, worth 4 dollars each, were given in exchange for 9 cows. What was the value of 1 cow?

45. 6 acres of corn yielded 50 bushels per acre, and the entire crop was hauled away in 12 wagon-loads. How many bushels were in each load?

46. 15 bars of iron, each weighing 12 pounds, were cast into 18 balls. What was the weight of one ball?

47. 40 kegs of cider, each containing 6 gallons, were emptied into 8 barrels. How many gallons were in each barrel?

48. Sold 75 cords of wood at 4 dollars a cord, and invested the money in 15 acres of land. What was the land worth per acre?

49. A traveler performed a journey in 10 days, at the rate of 24 miles per day. Had he done it in 8 days, how far would he have traveled daily?

50. A gardener planted 20 cabbages in each of 18 rows. Had the same number been planted in 15 rows, how many would have been in each row?

LESSON IX.

1. $\frac{3}{4}$ of 24 are how many times 5? 7?
2. $\frac{2}{3}$ of 30 are how many times 3? 9?
3. $\frac{5}{6}$ of 42 are how many times 6? 8?
4. $\frac{3}{5}$ of 45 are how many times 7? 10?
5. $\frac{4}{7}$ of 56 are how many times 5? 9?
6. $\frac{5}{8}$ of 64 are how many times 7? 11?
7. $\frac{7}{9}$ of 63 are how many times 8? 12?
8. $\frac{5}{8}$ of 72 are how many times 4? 7?
9. $\frac{9}{10}$ of 70 are how many times 8? 10?
10. $\frac{7}{11}$ of 88 are how many times 9? 11?
11. $\frac{5}{12}$ of 84 are how many times 3? 8?
12. $\frac{8}{11}$ of 99 are how many times 7? 11?
13. $\frac{16}{25}$ of 100 are how many times 5? 9?
14. $\frac{7}{12}$ of 96 are how many times 10? 12?
15. $\frac{5}{9}$ of 108 are how many times 7? 10?
16. $\frac{5}{12}$ of 132 are how many times 6? 8?

17. A farmer having 80 bushels of potatoes, exchanged $\frac{3}{4}$ of them for 8 barrels of flour. How many bushels were worth one barrel?

18. Owning 56 cords of wood, I gave three-eighths of it for 6 tons of hay. How many cords were worth one ton?

19. A man having 99 miles to travel, went $\frac{9}{11}$ of the distance in 8 days. How far did he travel per day?

20. A boy having 75 cents, gave $\frac{2}{5}$ of it for 4 quarts of chestnuts. What was the value of 1 quart?

21. A drover sold 25 hogs at 4 dollars a head, and invested $\frac{7}{10}$ of the money in cows at 14 dollars each. How many cows did he buy?

22. Bought 81 dozen eggs, and then exchanged $\frac{5}{9}$ of them for 12 gallons of molasses. How many dozen were given for 1 gallon?

LESSON X.

1. 3 is what part of 5?

Solution: It is 3 divided by 5, which is $\frac{3}{5}$. *Answer:* $\frac{3}{5}$ of 5.

2. 4 is what part of 7? 5 is what part of 9?
3. 7 is what part of 10? 11 is what part of 12?
4. What part of 11 is 9? What part of 10 is 3?
5. What part of 8 is 5? What part of 9 is 7?
6. What part is 8 of 13? What part is 9 of 16?
7. What part is 7 of 15? What part is 11 of 20?

NOTE.—*In all questions like the above, the number following the words "part of," is always the denominator or divisor of the fraction.*

8. $\frac{3}{8}$ of 24 is what part of 25?
9. $\frac{5}{6}$ of 12 is what part of 21?
10. $\frac{4}{9}$ of 27 is what part of 36?

11. $\frac{5}{7}$ of 21 is what part of 40?
12. $\frac{3}{5}$ of 45 is what part of 48?
13. $\frac{7}{10}$ of 50 is what part of 49?
14. $\frac{11}{12}$ of 48 is what part of 99?
15. $\frac{8}{15}$ of 45 is what part of $\frac{9}{11}$ of 44?
16. $\frac{7}{12}$ of 36 is what part of $\frac{8}{9}$ of 63?
17. $\frac{9}{16}$ of 64 is what part of $\frac{5}{7}$ of 84?
18. $\frac{8}{9}$ of 45 is what part of $\frac{3}{4}$ of 100?
19. $\frac{4}{11}$ of 77 is what part of $\frac{7}{9}$ of 54?
20. $\frac{9}{16}$ of 80 is what part of $\frac{5}{6}$ of 90?
21. $\frac{7}{12}$ of 72 is what part of $\frac{7}{11}$ of 99?
22. $\frac{5}{18}$ of 54 is what part of $\frac{25}{32}$ of 64?
23. $\frac{12}{13}$ of 52 is what part of $\frac{6}{7}$ of 84?
24. $\frac{15}{32}$ of 96 is what part of $\frac{5}{7}$ of 98?
25. $\frac{13}{25}$ of 75 is what part of $\frac{4}{5}$ of 65?

26. If a pound of raisins costs 8 cents, what part of a pound can be bought for 5 cents?

Solution: Such a part of a pound as 5 cents is part of 8 cents. 5 cents is $\frac{5}{8}$ of 8 cents. *Answer:* $\frac{5}{8}$ of a pound.

27. A boy had 12 chestnuts, and ate 7 of them. What part of the chestnuts did he eat?

28. A man owning 15 acres of land, sold 8 acres. What part of his land was sold?

29. A hunter trapped 16 quails, but 9 of them escaped. What part of them escaped?

30. Robert had 25 marbles, but lost 12 of them at play. What part of his marbles did he lose?

31. Stephen and Samuel together husked 20 rows of corn. Stephen husked 11 rows and Samuel husked 9. What part of the work did each do?

32. Two men bought a lot of lumber for 18 dollars. One paid 7 dollars, the other paid the remainder. What part of it belonged to each?

33. Two merchants bought 32 barrels of flour. One took 15 barrels, the other the remainder. What part of the flour did each take?

34. Three boys together picked 39 quarts of cherries. The first picked 14 quarts, the second 13 quarts, the third the remainder. What part of the cherries did each take?

35. Three farmers together owned 25 bushels of wheat, which they sold for 20 dollars. The first owned 7 bushels, the second, 8 bushels, the third, the remainder. What part of the money did the third receive?

LESSON XI.

1. What is $\frac{1}{3}$ of 5?

Solution: $\frac{1}{3}$ of 5 is $\frac{5}{3}$, equal to $1\frac{2}{3}$. *Answer:* $1\frac{2}{3}$.

2. What is $\frac{1}{2}$ of 5? $\frac{1}{4}$ of 5? $\frac{1}{5}$ of 5?
3. What is $\frac{1}{3}$ of 7? $\frac{1}{5}$ of 7? $\frac{1}{6}$ of 7? $\frac{1}{7}$ of 7?
4. What is $\frac{1}{3}$ of 10? $\frac{1}{5}$ of 11? $\frac{1}{7}$ of 12? $\frac{1}{9}$ of 13?
5. What is $\frac{1}{4}$ of 9? $\frac{1}{5}$ of 9? $\frac{1}{7}$ of 10? $\frac{1}{8}$ of 11?
6. What is $\frac{1}{8}$ of 13? $\frac{1}{9}$ of 14? $\frac{1}{10}$ of 17? $\frac{1}{12}$ of 19?
7. What is $\frac{1}{11}$ of 20? $\frac{1}{10}$ of 21? $\frac{1}{12}$ of 29? $\frac{1}{13}$ of 33?
8. What is $\frac{1}{8}$ of 47? $\frac{1}{9}$ of 50? $\frac{1}{10}$ of 53? $\frac{1}{12}$ of 65?
9. 16 are how many times 3? 5? 7? 9? 11?
10. 25 are how many times 4? 6? 8? 9? 12?
11. 32 are how many times 7? 9? 11? 13? 15?
12. 39 are how many times 5? 7? 8? 10? 11?
13. 49 are how many times 5? 6? 9? 11? 12?
14. 56 are how many times 5? 9? 11? 13? 15?
15. 64 are how many times 3? 5? 7? 9? 11?
16. 73 are how many times 6? 8? 9? 10? 12?
17. 81 are how many times 7? 8? 10? 11? 13?
18. 91 are how many times 8? 9? 10? 11? 12?

19. 100 are how many times 3? 7? 9? 11? 13?

20. 4 boys gathered 5 bushels of walnuts. What was the share of each?

Solution: Each boy's share was $\frac{1}{4}$ of 5 bushels, or $\frac{5}{4}$ bushels, equal to $1\frac{1}{4}$ bushels. *Answer:* $1\frac{1}{4}$ bushels.

21. If a man can walk 17 miles in 5 hours, how far can he walk in 1 hour?

22. 25 tons of hay were cut from 9 acres of land. What was the yield per acre?

23. If 8 yards of muslin cost 75 cents, what is the cost of 1 yard?

24. A father's age is 47 years, which is 12 times the age of his youngest son. What is the son's age?

25. Ten suits of clothes exactly alike were made from 77 yards of cloth. How many yards were in each suit?

LESSON XII.

1. 4 is $\frac{2}{5}$ of what number?

Solution: If 4 is $\frac{2}{5}$ of the number, $\frac{1}{5}$ of the number is $\frac{1}{2}$ of 4, which is 2; and $\frac{5}{5}$, or the number, is 5 times 2, which is 10. *Answer:* 10.

2. 6 is $\frac{1}{3}$ of what number? $\frac{2}{7}$? $\frac{3}{10}$?

3. 12 is $\frac{2}{5}$ of what number? $\frac{3}{8}$? $\frac{4}{9}$? $\frac{6}{11}$?

4. 18 is $\frac{1}{2}$ of what number? $\frac{2}{3}$? $\frac{3}{5}$? $\frac{6}{7}$? $\frac{9}{20}$?

5. 20 is $\frac{2}{7}$ of what number? $\frac{4}{9}$? $\frac{5}{8}$? $\frac{10}{13}$?

6. 24 is $\frac{2}{3}$ of what number? $\frac{3}{4}$? $\frac{4}{5}$? $\frac{6}{7}$? $\frac{8}{9}$? $\frac{12}{25}$?

7. 30 is $\frac{2}{5}$ of what number? $\frac{3}{8}$? $\frac{5}{9}$? $\frac{6}{11}$? $\frac{10}{21}$? $\frac{15}{32}$?

8. 36 is $\frac{3}{4}$ of what number? $\frac{4}{7}$? $\frac{6}{11}$? $\frac{9}{16}$? $\frac{12}{25}$? $\frac{18}{23}$?

9. 40 is $\frac{2}{5}$ of what number? $\frac{5}{7}$? $\frac{8}{9}$? $\frac{10}{13}$? $\frac{20}{21}$?

10. 45 is $\frac{3}{4}$ of what number? $\frac{5}{8}$? $\frac{9}{11}$? $\frac{15}{32}$?

11. 48 is $\frac{3}{5}$ of what number? $\frac{4}{7}$? $\frac{6}{11}$? $\frac{8}{9}$? $\frac{12}{25}$? $\frac{16}{17}$?

12. 50 is $\frac{2}{3}$ of what number? $\frac{5}{6}$? $\frac{10}{11}$? $\frac{25}{32}$?

13. A boy spent 10 cents, which was $\frac{2}{5}$ of all his money. How much had he?

Solution: If 10 cents was $\frac{2}{5}$ of his money, $\frac{1}{5}$ of it was $\frac{1}{2}$ of 10 cents, or 5 cents; and $\frac{5}{5}$ was 5 times 5 cents, or 25 cents. *Answer:* 25 cents.

14. In an orchard there are 18 plum trees, which is $\frac{3}{7}$ of the number of apple trees. How many apple trees are there?

15. A farmer sold 40 bushels of wheat, which was $\frac{5}{9}$ of his entire crop. How many bushels did he raise?

16. Sold a wagon for 75 dollars, which was $\frac{5}{4}$ of the cost. How much did I gain?

17. Harry lost 12 marbles, which were $\frac{3}{8}$ of all he owned. How many had he left?

18. Frank gave away 20 chestnuts, which were $\frac{2}{3}$ of what he had remaining. How many had he at first?

19. A owns 30 sheep, which is $\frac{3}{7}$ as many as B owns. How many do both own?

20. A merchant sold 6 barrels of flour for 36 dollars, which was $\frac{6}{5}$ of the cost. What was the cost per barrel?

21. A walked 21 miles, which was $\frac{7}{10}$ as far as B walked. How much farther did B walk than A?

22. A grocer sold $\frac{2}{9}$ of a barrel of coal oil, after which 35 gallons remained. How many gallons did he sell?

23. A boy played marbles; after winning $\frac{2}{7}$ as many as he had at first, he had 36 marbles. How many had he at first?

24. A man bought a cow; after having paid $\frac{8}{11}$ of the price, he owed 12 dollars. What was the price of the cow, and how much did he pay?

25. A farmer planted $\frac{7}{12}$ of his land in corn, and the remainder, which was 25 acres, in wheat. How many acres did he own, and how many were planted in corn?

26. A stick of timber stands $\frac{7}{9}$ in the air, and 6 feet in the ground. How long is the stick, and how many feet are in the air?

27. 8 of my sheep died, which was $\frac{2}{5}$ of what I had remaining. If I paid 3 dollars apiece for them, what did the entire flock cost?

28. A fruit-dealer bought 15 barrels of apples, which was $\frac{3}{7}$ as many as he already had. If he sold them all at 2 dollars a barrel, what did he receive for them?

29. Edwin's age is 14 years, which is $\frac{7}{9}$ of Herbert's. If Herbert's age is $\frac{6}{7}$ of George's what is the age of George?

30. A confectioner sold 3 boxes of candy; the first weighed 32 pounds, which was $\frac{4}{5}$ of the weight of the second, and the weight of the second was $\frac{10}{7}$ of the weight of the third. What was their entire weight?

31. A, B, and C dug a ditch. B dug $\frac{4}{5}$ as many rods as A, and C dug $\frac{7}{8}$ as many rods as B. If C dug 14 rods, how long was the ditch?

LESSON XIII.

1. 9 is $\frac{3}{7}$ of how many times 4?

Solution: If 9 is $\frac{3}{7}$ of a number, $\frac{1}{7}$ of it is $\frac{1}{3}$ of 9 which is 3; and $\frac{7}{7}$ are 7 times 3, which is 21. 21 divided by 4 = $5\frac{1}{4}$. *Answer:* $5\frac{1}{4}$.

2. 15 is $\frac{5}{8}$ of how many times 5? 6?
3. 21 is $\frac{7}{12}$ of how many times 7? 9?
4. 27 is $\frac{3}{5}$ of how many times 8? 5?
5. 36 is $\frac{4}{7}$ of how many times 10? 7?
6. 45 is $\frac{9}{11}$ of how many times 6? 11?
7. 56 is $\frac{8}{9}$ of how many times 8? 9?
8. 63 is $\frac{7}{10}$ of how many times 7? 5?
9. 72 is $\frac{9}{8}$ of how many times 9? 4?
10. 75 is $\frac{5}{4}$ of how many times 11? 6?

11. 84 is $\frac{12}{7}$ of how many times 5? 7?
12. 90 is $\frac{10}{3}$ of how many times 7? 9?
13. 96 is $\frac{16}{9}$ of how many times 9? 3?
14. 99 is $\frac{9}{11}$ of how many times 12? 11?
15. 100 is $\frac{5}{4}$ of how many times 11? 8?
16. 108 is $\frac{12}{7}$ of how many times 5? 7?
17. 120 is $\frac{6}{5}$ of how many times 9? 10?
18. 121 is $\frac{11}{10}$ of how many times 9? 11?
19. 132 is $\frac{11}{9}$ of how many times 10? 12?
20. 144 is $\frac{12}{5}$ of how many times 7? 4?
21. 112 is $\frac{8}{5}$ of how many times 9? 10?
22. 125 is $\frac{5}{4}$ of how many times 11? 20?
23. 130 is $\frac{10}{3}$ of how many times 8? 3?
24. 140 is $\frac{4}{3}$ of how many times 9? 15?
25. 150 is $\frac{6}{5}$ of how many times 12? 5?

LESSON XIV.

1. $\frac{5}{8}$ of 24 are $\frac{3}{5}$ of what number?

Solution: $\frac{5}{8}$ of 24 are 15. If 15 is $\frac{3}{5}$ of the number, $\frac{1}{5}$ of it is $\frac{1}{3}$ of 15, which is 5; and $\frac{5}{5}$ are 5 times 5, which is 25. *Awswer:* 25.

2. $\frac{3}{4}$ of 8 are $\frac{2}{3}$ of what number? $\frac{3}{7}$?
3. $\frac{4}{5}$ of 15 are $\frac{3}{8}$ of what number? $\frac{2}{5}$?
4. $\frac{5}{7}$ of 14 are $\frac{2}{9}$ of what number? $\frac{5}{8}$?
5. $\frac{4}{9}$ of 36 are $\frac{8}{11}$ of what number? $\frac{2}{5}$?
6. $\frac{5}{8}$ of 32 are $\frac{4}{7}$ of what number? $\frac{10}{9}$?
7. $\frac{7}{12}$ of 48 are $\frac{2}{3}$ of what number? $\frac{4}{9}$?
8. $\frac{4}{7}$ of 42 are $\frac{3}{7}$ of what number? $\frac{8}{11}$?
9. $\frac{5}{7}$ of 63 are $\frac{9}{10}$ of what number? $\frac{3}{5}$?
10. $\frac{8}{9}$ of 81 are $\frac{6}{5}$ of what number? $\frac{12}{7}$?
11. $\frac{7}{8}$ of 96 are $\frac{4}{3}$ of what number? $\frac{12}{11}$?
12. $\frac{7}{10}$ of 90 are $\frac{9}{10}$ of what number? $\frac{3}{4}$?
13. $\frac{12}{25}$ of 100 are $\frac{4}{9}$ of what number? $\frac{6}{7}$?

14. $\frac{8}{9}$ of 108 are $\frac{3}{2}$ of what number? $\frac{12}{5}$?

15. $\frac{5}{6}$ of 120 are $\frac{4}{5}$ of what number? $\frac{10}{11}$?

16. $\frac{7}{10}$ of 150 are $\frac{3}{4}$ of what number? $\frac{5}{6}$?

17. Ellis gathered 10 quarts of hazelnuts, and $\frac{4}{5}$ of what he gathered equaled $\frac{2}{3}$ of what Wesley gathered. How many quarts did Wesley gather?

18. Charles walked 18 miles, and $\frac{8}{9}$ of the distance Charles walked was $\frac{4}{5}$ of the distance that Clifford walked. How far did Clifford walk?

19. In a pasture there are 21 cows, and $\frac{5}{7}$ of the number of cows equals $\frac{3}{8}$ of the number of sheep. How many sheep are there?

20. A and B went hunting. A killed 24 birds, and $\frac{7}{8}$ of the number A killed were $\frac{3}{4}$ of the number B killed. How many did both kill?

21. Brown's age is 32 years, which is $\frac{8}{9}$ of Smith's. If Smith's age is $\frac{6}{5}$ of Robinson's, what are the ages of Smith and Robinson?

LESSON XV.

1. Add $\frac{2}{3}$ and $\frac{3}{4}$.

Solution: The common denominator is 12. $\frac{2}{3}$ are $\frac{8}{12}$; $\frac{3}{4}$ are $\frac{9}{12}$. $\frac{8}{12}+\frac{9}{12}$ are $\frac{17}{12}=1\frac{5}{12}$. *Answer:* $1\frac{5}{12}$.

2. Add $\frac{1}{2}$ and $\frac{1}{5}$; $\frac{1}{3}$ and $\frac{1}{5}$; $\frac{1}{4}$ and $\frac{1}{5}$.

3. Add $\frac{1}{2}$ and $\frac{2}{3}$; $\frac{1}{3}$ and $\frac{3}{4}$; $\frac{1}{4}$ and $\frac{3}{5}$.

4. Add $\frac{2}{3}$ and $\frac{3}{5}$; $\frac{3}{4}$ and $\frac{4}{5}$; $\frac{2}{5}$ and $\frac{5}{6}$.

5. Add $\frac{3}{4}$ and $\frac{2}{9}$; $\frac{2}{5}$ and $\frac{3}{7}$; $\frac{3}{5}$ and $\frac{3}{8}$.

6. Add $\frac{2}{3}$ and $\frac{2}{7}$; $\frac{3}{4}$ and $\frac{2}{7}$; $\frac{2}{3}$ and $\frac{5}{8}$.

7. Add $\frac{3}{5}$ and $\frac{4}{9}$; $\frac{5}{6}$ and $\frac{3}{7}$; $\frac{2}{3}$ and $\frac{3}{10}$.

8. Add $\frac{4}{7}$ and $\frac{2}{9}$; $\frac{3}{7}$ and $\frac{5}{8}$; $\frac{3}{5}$ and $\frac{5}{12}$.

9. Add $\frac{3}{4}$ and $\frac{3}{11}$; $\frac{2}{5}$ and $\frac{7}{12}$; $\frac{3}{8}$ and $\frac{5}{9}$.

10. Add $\frac{3}{10}$ and $\frac{7}{9}$; $\frac{3}{7}$ and $\frac{7}{12}$; $\frac{3}{4}$ and $\frac{6}{25}$.

11. Add $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$; $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$; $\frac{1}{3}$, $\frac{1}{5}$, and $\frac{4}{15}$.

12. Add $\frac{1}{3}$, $\frac{1}{6}$, and $\frac{1}{9}$; $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{8}$; $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{3}{10}$.

13. Add $\frac{2}{5}$, $\frac{1}{6}$, and $\frac{7}{15}$; $\frac{1}{4}$, $\frac{2}{7}$, and $\frac{5}{14}$; $\frac{1}{4}$, $\frac{2}{9}$, and $\frac{5}{12}$.

14. Add $\frac{3}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$; $\frac{2}{3}$, $\frac{1}{5}$, and $\frac{1}{9}$; $\frac{3}{8}$, $\frac{5}{12}$, and $\frac{3}{16}$.

15. Add $\frac{2}{5}$, $\frac{3}{10}$, and $\frac{7}{25}$; $\frac{3}{7}$, $\frac{3}{8}$, and $\frac{3}{14}$; $\frac{3}{10}$, $\frac{5}{12}$, and $\frac{7}{15}$.

16. Add $\frac{2}{3}$, $\frac{2}{15}$, and $\frac{2}{25}$; $\frac{2}{7}$, $\frac{3}{10}$, and $\frac{5}{14}$; $\frac{3}{8}$, $\frac{3}{16}$, and $\frac{3}{20}$.

17. Add $\frac{5}{12}$, $\frac{5}{14}$, and $\frac{5}{21}$; $\frac{3}{10}$, $\frac{4}{15}$, and $\frac{5}{18}$; $\frac{5}{12}$, $\frac{5}{16}$, and $\frac{5}{24}$.

18. Add $\frac{3}{10}$, $\frac{7}{20}$, and $\frac{9}{25}$; $\frac{1}{8}$, $\frac{5}{12}$, and $\frac{5}{18}$; $\frac{2}{9}$, $\frac{7}{11}$, and $\frac{5}{33}$.

19. Add $3\frac{3}{4}$ and $4\frac{1}{6}$.

Solution: $3+4=7$; $\frac{3}{4}=\frac{9}{12}$; $\frac{1}{6}=\frac{2}{12}$; $\frac{9}{12}+\frac{2}{12}=\frac{11}{12}$, and this added to $7=7\frac{11}{12}$. *Answer:* $7\frac{11}{12}$.

20. Add $2\frac{1}{3}$ and $4\frac{1}{2}$; $1\frac{1}{2}$ and $2\frac{2}{5}$; $3\frac{1}{3}$ and $4\frac{3}{5}$.

21. Add $4\frac{2}{3}$ and $5\frac{4}{9}$; $5\frac{1}{6}$ and $6\frac{5}{9}$; $7\frac{5}{6}$ and $6\frac{3}{8}$.

22. Add $3\frac{3}{10}$ and $5\frac{3}{4}$; $2\frac{5}{12}$ and $3\frac{4}{9}$; $6\frac{3}{8}$ and $4\frac{7}{10}$.

23. Add $2\frac{1}{4}$, $3\frac{3}{10}$, and $4\frac{4}{15}$; $1\frac{2}{5}$, $2\frac{4}{9}$, and $3\frac{2}{15}$.

24. Add $4\frac{2}{9}$, $5\frac{5}{12}$, and $6\frac{5}{18}$; $3\frac{3}{8}$, $5\frac{7}{10}$, and $7\frac{8}{20}$.

25. Add $1\frac{1}{6}$, $2\frac{1}{8}$, $3\frac{1}{12}$, and $4\frac{1}{16}$; $2\frac{8}{10}$, $3\frac{2}{20}$, $4\frac{8}{25}$, and $\frac{11}{50}$.

LESSON XVI.

1. Edward gave $\$\frac{3}{10}$ for a spelling book, and $\$\frac{1}{4}$ for a reader. How much did he pay for both?

NOTE.—*The sign $ is read* dollar *or* dollars.

2. Earl bought a story book; he read $\frac{1}{3}$ of it the first day, and $\frac{2}{5}$ of it the next. What part of the book did he read in the two days?

3. Jennie had a number of filberts, and gave $\frac{1}{3}$ of them to Mary, and $\frac{3}{8}$ to Lucy. What part of them did she give away?

4. William spends $\frac{2}{9}$ of his time in working, and $\frac{1}{6}$ of it in studying. What part of his time is so occupied?

5. A traveler went $\frac{1}{6}$ of a journey the first day, $\frac{3}{10}$ of

it the second, and $\frac{4}{15}$ of it the third. What part of the distance had he then traveled?

6. A farmer planted $\frac{3}{8}$ of his land in corn, $\frac{3}{10}$ of it in wheat, and $\frac{3}{20}$ in potatoes. What part of his land did he cultivate?

7. A coat cost \$$8\frac{1}{2}$, a vest \$$2\frac{3}{4}$, and a hat \$$3\frac{3}{10}$. Find the total cost?

8. There are three pieces of cloth; the first contains $4\frac{1}{6}$ yards, the second, $5\frac{4}{9}$ yards, and the third, $6\frac{7}{18}$ yards. How many yards in all?

9. A built $8\frac{1}{6}$ rods of fence, B, $10\frac{7}{10}$ rods, C, $12\frac{4}{15}$ rods. How many rods did all build?

10. A grocer sold $3\frac{3}{4}$ barrels of flour at one time, $4\frac{2}{7}$ barrels at another, and $5\frac{5}{14}$ barrels at another. How much did he sell altogether?

11. A farmer sowed $6\frac{2}{9}$ acres in oats, $7\frac{7}{12}$ acres in barley, and $3\frac{5}{18}$ acres in rye. How many acres were sown?

12. Three loads of wheat measured as follows: $22\frac{3}{8}$ bushels, $24\frac{5}{16}$ bushels, and $26\frac{7}{32}$ bushels. What was the total number of bushels?

13. I paid \$$18\frac{3}{4}$ for a carpet, \$$20\frac{7}{10}$ for furniture, and \$$10\frac{11}{20}$ for a stove. How much did I pay for all?

14. The weight of three stacks of hay is as follows: $4\frac{3}{10}$ tons, $4\frac{5}{16}$ tons, $4\frac{7}{20}$ tons. What is the entire weight?

15. A mechanic worked $8\frac{3}{10}$ hours on Monday, $9\frac{5}{12}$ hours on Tuesday, $10\frac{2}{15}$ hours on Wednesday, and $12\frac{3}{20}$ hours on Thursday. How many hours was he employed?

LESSON XVII.

1. What is the difference between $\frac{2}{3}$ and $\frac{3}{5}$?

Solution: The common denominator is 15. $\frac{2}{3}$ are $\frac{10}{15}$, and $\frac{3}{5}$ are $\frac{9}{15}$; $\frac{10}{15}-\frac{9}{15}=\frac{1}{15}$. *Answer:* $\frac{1}{15}$.

2. Subtract $\frac{1}{3}$ from $\frac{1}{2}$; $\frac{1}{4}$ from $\frac{1}{3}$; $\frac{1}{5}$ from $\frac{1}{4}$.
3. Subtract $\frac{1}{3}$ from $\frac{2}{5}$; $\frac{1}{3}$ from $\frac{3}{4}$; $\frac{1}{2}$ from $\frac{3}{5}$.
4. Subtract $\frac{2}{3}$ from $\frac{3}{4}$; $\frac{2}{5}$ from $\frac{2}{3}$; $\frac{3}{4}$ from $\frac{4}{5}$.
5. Subtract $\frac{2}{5}$ from $\frac{3}{4}$; $\frac{1}{2}$ from $\frac{5}{9}$; $\frac{2}{3}$ from $\frac{6}{7}$.
6. Subtract $\frac{3}{8}$ from $\frac{2}{3}$; $\frac{3}{7}$ from $\frac{3}{4}$; $\frac{3}{10}$ from $\frac{1}{3}$.
7. Subtract $\frac{4}{9}$ from $\frac{3}{4}$; $\frac{3}{7}$ from $\frac{4}{5}$; $\frac{2}{5}$ from $\frac{5}{8}$.
8. Subtract $\frac{3}{5}$ from $\frac{7}{9}$; $\frac{4}{7}$ from $\frac{5}{6}$; $\frac{5}{8}$ from $\frac{5}{7}$.
9. Subtract $\frac{4}{5}$ from $\frac{11}{12}$; $\frac{4}{7}$ from $\frac{8}{9}$; $\frac{7}{10}$ from $\frac{6}{7}$.
10. Subtract $\frac{5}{8}$ from $\frac{7}{9}$; $\frac{7}{12}$ from $\frac{5}{7}$; $\frac{7}{16}$ from $\frac{3}{5}$.
11. Subtract $\frac{7}{10}$ from $\frac{8}{9}$; $\frac{5}{18}$ from $\frac{2}{5}$; $\frac{16}{25}$ from $\frac{3}{4}$.
12. Subtract $\frac{3}{10}$ from $\frac{8}{15}$; $\frac{5}{12}$ from $\frac{11}{18}$; $\frac{5}{24}$ from $\frac{7}{16}$.
13. Take $2\frac{1}{2}$ from $3\frac{1}{3}$.

Solution: $2\frac{1}{2}=2\frac{3}{6}$; $3\frac{1}{3}=3\frac{2}{6}$; $3\frac{2}{6}-2\frac{3}{6}=\frac{5}{6}$. *Answer:* $\frac{5}{6}$.

14. Take $3\frac{2}{3}$ from $5\frac{3}{4}$; $4\frac{1}{2}$ from $6\frac{3}{5}$; $5\frac{2}{3}$ from $7\frac{4}{5}$.
15. Take $4\frac{3}{4}$ from $8\frac{9}{10}$; $5\frac{4}{9}$ from $9\frac{5}{6}$; $6\frac{2}{5}$ from $8\frac{3}{4}$.
16. Take $7\frac{3}{8}$ from $10\frac{7}{12}$; $6\frac{7}{10}$ from $11\frac{5}{6}$; $5\frac{5}{9}$ from $7\frac{7}{12}$.
17. Take $2\frac{4}{5}$ from $7\frac{7}{10}$; $4\frac{5}{6}$ from $8\frac{4}{9}$; $5\frac{3}{8}$ from $10\frac{1}{6}$.
18. Take $6\frac{2}{3}$ from $9\frac{3}{5}$; $5\frac{7}{10}$ from $10\frac{3}{4}$; $7\frac{5}{8}$ from $11\frac{5}{12}$.

Suggestion: In finding the difference between two mixed numbers, reduce the fractional parts to a common denominator. Then, if the numerator of the fraction in the subtrahend is greater than the numerator of the fraction in the minuend, add the numerator and the denominator of the fraction in the minuend, and subtract the numerator of the other fraction from the sum, placing the difference over the common denominator. This is the same as borrowing one from the upper number, and reducing it to the denominator of the fraction.

LESSON XVIII.

1. Samuel bought a quart of strawberries. He gave his brother $\frac{2}{5}$, and his sister $\frac{3}{10}$ of them. How much more did the brother receive than the sister?

2. Wilbur had $\$\frac{3}{4}$, and his father gave him enough to make $\$\frac{9}{10}$. What part of a dollar did his father give him?

3. In an orchard $\frac{3}{8}$ are apple trees, and $\frac{1}{6}$ are pear trees. By what part of the orchard do the apple trees exceed the pear?

4. A speculator invested $\frac{4}{9}$ of his money in cattle, and $\frac{5}{12}$ of it in horses. In which did he invest the more, and how much more?

5. $\frac{5}{8}$ of a farm were planted in corn, $\frac{8}{10}$ in barley, and the remainder in oats. How much more was planted in corn than in barley? What part in oats?

6. A man dying left $\frac{3}{8}$ of his estate to his son, $\frac{1}{3}$ to his daughter, and the remainder to his widow. How much more did the son receive than the daughter? What was the widow's share?

7. A man owning $18\frac{3}{4}$ acres of land, sold a part of it, and had $12\frac{5}{8}$ acres remaining. How many acres did he sell?

8. A lady bought $10\frac{5}{9}$ yards of muslin. After using $6\frac{1}{2}$ yards, how much remained?

9. During a certain month, A worked $24\frac{5}{8}$ days, and B $19\frac{5}{6}$ days. How much longer did A work than B?

10. One cannon ball weighed $18\frac{3}{4}$ pounds, and another weighed $24\frac{5}{16}$ pounds. What was their difference in weight?

11. Bought some furniture for $\$37\frac{3}{4}$, and sold it for $\$30\frac{9}{10}$. Find my loss.

12. One vessel sailed $50\frac{5}{6}$ miles, and another sailed

$44\frac{11}{12}$ miles. How much farther did the first sail than the second?

13. Mr. Brown's age is $49\frac{5}{8}$ years, and Mr. Smith's is $38\frac{4}{5}$ years. How much older is Mr. Brown than Mr. Smith?

LESSON XIX.

1. A lady bought $3\frac{3}{4}$ yards of muslin at one store, and $6\frac{2}{3}$ yards at another. After having used $7\frac{5}{6}$ yards, how much remained?

2. Walter earned \$$11\frac{3}{5}$. He gave \$$6\frac{3}{4}$ for a suit of clothes, \$$3\frac{7}{10}$ for a pair of boots, and spent the rest for a hat. What did the hat cost?

3. A stick of timber stands $\frac{1}{12}$ in the earth, $\frac{3}{8}$ in the water, the rest in the air. What part is in the air?

4. A man having 50 miles to travel, went $15\frac{5}{9}$ miles the first day, and $16\frac{5}{6}$ miles the second day, and the remainder the third day. How far did he travel the third day?

5. From $10\frac{1}{2}$ take the difference between $6\frac{5}{8}$ and $9\frac{3}{4}$?

6. A has \$$9\frac{8}{10}$, and B, \$$3\frac{1}{4}$ less. C has as much as the other two. How much has C?

7. One suit of clothes contains $6\frac{7}{9}$ yards, another $6\frac{5}{6}$ yards, and a third contains $5\frac{1}{2}$ yards less than the other two combined. How many yards are in the third suit?

8. There are $4\frac{7}{10}$ tons of hay in one stack, and $1\frac{1}{2}$ tons less in another. How many tons are there in both?

9. A dug $6\frac{3}{4}$ rods of ditch, which was $2\frac{1}{2}$ rods more than B dug. If C dug as many as both A and B, how many rods did all dig?

10. John gathered $6\frac{7}{8}$ pecks of walnuts, James, $1\frac{3}{4}$ pecks fewer, and Sidney gathered $5\frac{1}{2}$ pecks less than the other two together. How many pecks did Sidney gather?

11. There is a certain number from which if you take $7\frac{5}{6}—3\frac{8}{15}$ the result will be $16\frac{4}{5}$. What is the number?

12. There is a number to which if you add $5\frac{3}{4}+8\frac{7}{10}$ the sum will be $25\frac{1}{2}$. What is the number?

13. Robert is $4\frac{7}{12}$ years younger than Henry; and William is $3\frac{1}{3}$ years older than Robert. If William's age is $15\frac{3}{4}$ years, how old is Henry?

14. $18\frac{3}{4}—10\frac{1}{6}+12\frac{2}{9}—5\frac{5}{12}=$ what?

15. On counting their money, it was found that A had $\$31\frac{1}{4}$, which was $\$10\frac{7}{10}$ less than B's, and $\$4\frac{9}{20}$ more than C's. How much had all?

LESSON XX.

1. What are 5 times $\frac{2}{3}$?

Solution: 5 times $\frac{2}{3}$ are $\frac{10}{3}$, equal to $3\frac{1}{3}$. *Answer:* $3\frac{1}{3}$.

2. What are 4 times $\frac{2}{5}$? 7 times $\frac{2}{3}$? 9 times $\frac{3}{4}$?

3. What are 3 times $\frac{5}{8}$? 6 times $\frac{4}{7}$? 8 times $\frac{5}{9}$?

4. What are 5 times $\frac{3}{7}$? 7 times $\frac{7}{8}$? 9 times $\frac{4}{5}$?

5. What are 4 times $\frac{8}{9}$? 6 times $\frac{3}{5}$? 10 times $\frac{5}{7}$?

6. What are 6 times $\frac{4}{11}$? 7 times $\frac{7}{9}$? 8 times $\frac{7}{11}$?

7. What are 9 times $\frac{7}{10}$? 10 times $\frac{8}{9}$? 11 times $\frac{5}{6}$?

8. What are 10 times $\frac{5}{3}$? 11 times $\frac{3}{4}$? 12 times $\frac{4}{5}$?

9. What are 6 times $\frac{3}{4}$? 9 times $\frac{5}{6}$? 4 times $\frac{5}{8}$?

10. What are 10 times $\frac{3}{8}$? 8 times $\frac{5}{6}$? 12 times $\frac{7}{8}$?

11. What are 12 times $\frac{5}{9}$? 10 times $\frac{3}{4}$? 9 times $\frac{11}{12}$?

12. What are 4 times $\frac{7}{8}$? 6 times $\frac{8}{9}$? 12 times $\frac{5}{8}$?

13. What are 15 times $\frac{5}{6}$? 16 times $\frac{3}{10}$? 18 times $\frac{5}{12}$?

14. A father gave $\$\frac{3}{4}$ to each of his five children. How many dollars did he give?

15. Isaac gave $\frac{4}{5}$ of a pint of cider to each of his four playmates. How many pints did it take?

16. A man built a fence in 6 days, at the rate of $\frac{3}{5}$ rods per day. How long was the fence?

17. A teamster hauled 9 loads of hay, each weighing $\frac{7}{8}$ of a ton. What was the total weight?

18. What would be the value of 12 bushels of wheat at $\$\frac{9}{10}$ a bushel?

19. A tailor made 8 vests, each containing $\frac{5}{6}$ of a yard of cloth. How many yards were required?

20. A vessel containing $\frac{7}{2}$ of a gallon was emptied 9 times into a barrel. How many gallons did the barrel hold?

21. A tract of land was divided into 25 building lots, each containing $\frac{3}{8}$ of an acre. How many acres were in the tract?

LESSON XXI.

1. What are $\frac{4}{5}$ of 8?

Solution: $\frac{1}{5}$ of 8 is $\frac{8}{5}$, and $\frac{4}{5}$ of 8 are 4 times $\frac{8}{5}$, which are $\frac{32}{5} = 6\frac{2}{5}$. *Answer:* $6\frac{2}{5}$.

2. What are $\frac{2}{3}$ of 5? $\frac{3}{4}$ of 7? $\frac{2}{5}$ of 8?
3. What are $\frac{3}{4}$ of 9? $\frac{5}{6}$ of 11? $\frac{8}{8}$ of 12?
4. What are $\frac{4}{9}$ of 10? $\frac{7}{8}$ of 9? $\frac{9}{10}$ of 3?
5. What are $\frac{5}{7}$ of 12? $\frac{4}{5}$ of 11? $\frac{3}{8}$ of 10?
6. What are $\frac{7}{8}$ of 7? $\frac{5}{4}$ of 9? $\frac{10}{3}$ of 2?
7. What are $\frac{7}{10}$ of 8? $\frac{10}{9}$ of 7? $\frac{7}{5}$ of 9?
8. What are $\frac{8}{5}$ of 6? $\frac{5}{2}$ of 5? $\frac{7}{4}$ of 3?
9. What are $\frac{5}{9}$ of 6? $\frac{3}{10}$ of 12? $\frac{5}{8}$ of 11?
10. What are $\frac{5}{6}$ of 10? $\frac{6}{7}$ of 11? $\frac{7}{8}$ of 12?
11. What are $\frac{8}{9}$ of 8? $\frac{11}{10}$ of 7? $\frac{12}{7}$ of 6?
12. What are $\frac{7}{5}$ of 8? $\frac{9}{7}$ of 6? $\frac{10}{3}$ of 4?
13. What are $\frac{7}{12}$ of 9? $\frac{8}{15}$ of 10? $\frac{3}{20}$ of 12?

14. If 5 bushels of corn cost \$3, what will 4 bushels cost?

Solution: 1 bushel will cost $\frac{1}{5}$ of \$3, which is $\$\frac{3}{5}$, and 4 bushels will cost 4 times $\$\frac{3}{5}$, or $\$\frac{12}{5} = \$2\frac{2}{5}$. *Answer:* $\$2\frac{2}{5}$.

15. If 6 men can reap a field in 8 days, how long would it take 9 men?

16. If an upright stick, 10 feet high, cast a shadow 7 feet long, how long a shadow will be cast at the same time by a stick 12 feet high?

17. A man owning 20 acres of land, sowed $\frac{5}{8}$ of it in wheat, and the remainder in barley. How many acres were sown in each?

18. If a man can perform a certain task in 12 days of 9 hours each, in how many days of 10 hours each could he do the same work?

19. If 3 pipes of the same size fill a tank in 16 minutes, in how many minutes could 5 such pipes fill it?

20. If it costs 75 cents to drive 10 miles, what should it cost to drive 12 miles?

LESSON XXII.

1. How many are 5 times $2\frac{1}{2}$?

Solution: 5 times 2 are 10; 5 times $\frac{1}{2}$ are $\frac{5}{2}=2\frac{1}{2}$; and this added to $10=12\frac{1}{2}$. *Answer:* $12\frac{1}{2}$.

2. How many are 4 times $3\frac{1}{8}$? 2 times $5\frac{1}{2}$?
3. How many are 3 times $4\frac{2}{5}$? 5 times $3\frac{2}{3}$?
4. How many are 6 times $3\frac{3}{4}$? 4 times $6\frac{2}{3}$?
5. How many are 7 times $2\frac{2}{5}$? 6 times $4\frac{2}{7}$?
6. How many are 5 times $5\frac{3}{8}$? 7 times $3\frac{5}{6}$?
7. How many are 6 times $5\frac{3}{5}$? 8 times $7\frac{1}{2}$?
8. How many are 9 times $6\frac{3}{4}$? 7 times $7\frac{2}{3}$?
9. How many are 8 times $5\frac{5}{9}$? 10 times $4\frac{4}{5}$?
10. How many are 9 times $4\frac{2}{7}$? 11 times $3\frac{3}{5}$?
11. How many are 7 times $3\frac{3}{5}$? 8 times $6\frac{2}{3}$?
12. How many are 10 times $5\frac{5}{6}$? 12 times $8\frac{1}{3}$?
13. How many are 6 times $6\frac{3}{8}$? 7 times $4\frac{2}{5}$?
14. How many are 11 times $4\frac{4}{9}$? 9 times $11\frac{1}{9}$?

15. How many are 6 times $12\frac{1}{2}$? 12 times $6\frac{3}{4}$?

16. How many are 10 times $5\frac{5}{9}$? 7 times $5\frac{5}{8}$?

17. How many are 8 times $8\frac{7}{8}$? 9 times $10\frac{2}{3}$?

18. How many are 11 times $9\frac{1}{11}$? 12 times $5\frac{5}{6}$?

19. How many are 9 times $9\frac{3}{8}$? 10 times $10\frac{2}{3}$?

20. How many are 11 times $11\frac{10}{11}$? 12 times $8\frac{5}{9}$?

21. If a mechanic earn \$$2\frac{3}{4}$ in one day, what will he earn in 9 days?

22. If a team of horses can draw $1\frac{5}{8}$ tons in one load, how much can they draw in 7 loads?

23. If one acre of land produce $15\frac{3}{5}$ bushels of wheat, how many bushels should 6 acres produce?

24. 12 men each built $5\frac{5}{9}$ rods of fence. How many rods did all build?

25. If a regiment of soldiers consume $9\frac{9}{10}$ barrels of beef in one day, how many barrels will they consume in 10 days?

LESSON XXIII.

1. Three times $6\frac{2}{3}$ are how many times 6? 8? 9? 10?

2. Five times $5\frac{3}{5}$ are how many times 3? 7? 8? 9?

3. Seven times $6\frac{3}{7}$ are how many times 5? 6? 9? 10?

4. Four times $12\frac{1}{4}$ are how many times 6? 7? 9? 11?

5. Eight times $9\frac{3}{8}$ are how many times 6? 7? 9? 10?

6. Six times $11\frac{5}{6}$ are how many times 7? 8? 9? 10?

7. Nine times $8\frac{8}{9}$ are how many times 7? 8? 10? 11?

8. Eleven times $4\frac{6}{11}$ are how many times 6? 8? 9? 12?

9. Ten times $7\frac{7}{10}$ are how many times 8? 9? 11? 12?

10. Eight times $5\frac{7}{8}$ are how many times 4? 5? 6? 8?

11. Nine times $6\frac{2}{9}$ are how many times 6? 8? 10? 12?

12. Twelve times $6\frac{5}{12}$ are how many times 8? 9? 11? 12?

13. A man dying, left his farm to his 5 children, giving to each $12\frac{3}{5}$ acres. Had there been 6 children, how many acres would each have received?

14. A laborer cut $2\frac{5}{8}$ tons of clover a day for 8 days. Had he done the same work in 6 days, how many tons per day would he have cut?

15. A certain work can be done by 9 men in $8\frac{1}{3}$ days. In how many days can 10 men do the same work?

16. How many dozen eggs, at 12 cents a dozen, should be given for $10\frac{8}{9}$ yards of muslin, at 9 cents a yard?

17. If A travels $4\frac{5}{6}$ miles in an hour, and B 5 miles, in how many hours can B travel as far as A travels in 12 hours?

18. How many barrels of oil, at \$9 a barrel, will be equal in value to 10 tons of hay, at $\$10\frac{4}{5}$ a ton?

19. A company of men built a bridge in 9 days by working $11\frac{2}{3}$ hours a day. Had they worked but 10 hours a day, how long would it have taken them?

20. A field containing 20 acres yielded $2\frac{1}{2}$ tons of hay per acre. Had the same quantity been raised on 25 acres, what would have been the yield per acre?

21. If 12 horses consume 75 bushels of corn in a certain time, how many bushels would 10 horses require for the same time?

22. A man spent all his money for sixteen hogs, at $\$6\frac{1}{4}$ apiece. Had they cost but \$5 apiece, how many could he have bought?

23. 6 pipes filled a reservoir in $10\frac{2}{3}$ hours. In what time could 8 such pipes have filled it?

24. 9 men have provisions for $8\frac{8}{9}$ days. How long would the same provisions last 12 men?

25. Exchanged $12\frac{3}{8}$ barrels of sugar, worth $8 a barrel, for wood, at $6 a cord. How many cords did I receive?

26. Eleven men dug 100 rods of ditch in one week. How many rods could 7 men have dug in the same time?

27. 15 cubic yards of earth were removed in 12 cart-loads. How many cubic yards could have been removed in 20 cart-loads?

28. The freight on 10 car-loads of coal was $54. At the same rate, what should have been charged for 8 car-loads?

29. A man accomplished a journey in 9 days, at the rate of $16\frac{2}{3}$ miles per day. Had he performed the same journey in 12 days, how far would he have traveled daily?

30. 12 men were engaged to do a piece of work in $10\frac{2}{3}$ days. It was found necessary to complete it in 8 days. How many more men were employed?

LESSON XXIV.

1. Multiply $\frac{2}{3}$ by $\frac{4}{5}$.

Solution 1: $\frac{1}{3}$ of $\frac{4}{5}$ is $\frac{4}{15}$; and $\frac{2}{3}$ of $\frac{4}{5}$ are 2 times $\frac{4}{15}$, which are $\frac{8}{15}$. *Answer:* $\frac{8}{15}$.

Solution 2: The product of the numerators is 8; of the denominators, 15. The answer is $\frac{8}{15}$.

2. Multiply $\frac{5}{6}$ by $\frac{3}{8}$.

Suggestion: If any of the terms contain a common factor, it can be suppressed, and the remaining factors multiplied together; or, if preferred, the numerators and the denominators may be multiplied together first, and the result reduced to its lowest terms.

3. Multiply $\frac{1}{2}$ by $\frac{3}{4}$; $\frac{2}{3}$ by $\frac{2}{5}$; $\frac{3}{4}$ by $\frac{5}{8}$; $\frac{4}{5}$ by $\frac{3}{7}$.
4. Multiply $\frac{2}{3}$ by $\frac{5}{7}$; $\frac{3}{5}$ by $\frac{4}{5}$; $\frac{7}{8}$ by $\frac{5}{6}$; $\frac{3}{10}$ by $\frac{1}{4}$
5. Multiply $\frac{5}{8}$ by $\frac{2}{3}$; $\frac{4}{7}$ by $\frac{5}{9}$; $\frac{5}{6}$ by $\frac{5}{7}$; $\frac{3}{8}$ by $\frac{9}{10}$.
6. Multiply $\frac{5}{7}$ by $\frac{3}{8}$; $\frac{4}{9}$ by $\frac{4}{5}$; $\frac{7}{10}$ by $\frac{3}{5}$; $\frac{5}{12}$ by $\frac{7}{9}$.
7. What are $\frac{3}{4}$ of $\frac{2}{5}$? $\frac{2}{7}$ of $\frac{5}{6}$? $\frac{3}{5}$ of $\frac{4}{9}$? $\frac{5}{8}$ of $\frac{7}{10}$?
8. What are $\frac{4}{7}$ of $\frac{14}{15}$? $\frac{9}{10}$ of $\frac{5}{11}$? $\frac{8}{9}$ of $\frac{5}{16}$? $\frac{7}{12}$ of $\frac{11}{21}$?
9. What are $\frac{6}{7}$ of $\frac{4}{9}$? $\frac{8}{15}$ of $\frac{10}{11}$? $\frac{12}{25}$ of $\frac{7}{18}$? $\frac{5}{8}$ of $\frac{16}{17}$?
10. What are $\frac{5}{6}$ of $\frac{9}{11}$? $\frac{4}{9}$ of $\frac{5}{6}$? $\frac{15}{16}$ of $\frac{9}{10}$? $\frac{3}{14}$ of $\frac{21}{25}$?
11. What are $\frac{6}{5}$ of $\frac{7}{12}$? $\frac{4}{3}$ of $\frac{5}{8}$? $\frac{9}{7}$ of $\frac{5}{18}$? $\frac{10}{9}$ of $\frac{6}{7}$?
12. What are $\frac{12}{7}$ of $\frac{5}{8}$? $\frac{9}{5}$ of $\frac{7}{6}$? $\frac{5}{3}$ of $\frac{11}{10}$? $\frac{9}{8}$ of $\frac{12}{11}$?
13. What are $\frac{4}{9}$ of $\frac{21}{10}$? $\frac{8}{15}$ of $\frac{25}{28}$? $\frac{9}{10}$ of $\frac{5}{6}$? $\frac{12}{7}$ of $\frac{14}{15}$?
14. What are $\frac{9}{4}$ of $\frac{10}{3}$? $\frac{14}{15}$ of $\frac{10}{21}$? $\frac{10}{3}$ of $\frac{9}{25}$? $\frac{8}{9}$ of $\frac{15}{16}$?
15. What are $\frac{5}{8}$ of $\frac{2}{3}$ of $\frac{9}{10}$?

Solution: $\frac{5}{8}$ of $\frac{2}{3}$ are $\frac{10}{24}=\frac{5}{12}$; $\frac{5}{12}$ of $\frac{9}{10}=\frac{3}{8}$. *Answer:* $\frac{3}{8}$.

16. What are $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{7}{8}$? $\frac{9}{4}$ of $\frac{2}{5}$ of $\frac{10}{3}$?
17. What are $\frac{3}{4}$ of $\frac{6}{7}$ of $\frac{8}{9}$? $\frac{7}{12}$ of $\frac{8}{15}$ of $\frac{9}{14}$?
18. What are $\frac{5}{8}$ of $\frac{22}{25}$ of $\frac{10}{33}$? $\frac{9}{10}$ of $\frac{15}{16}$ of $\frac{22}{27}$?

19. Hiram gathered $\frac{5}{8}$ of a bushel of hickory nuts, and sold $\frac{2}{3}$ of them. What part of a bushel did he sell?

20. Owning $\frac{9}{16}$ of a tract of woodland, I sold $\frac{4}{5}$ of my share. What part of the whole tract did I sell?

21. What would be the cost of $4\frac{1}{2}$ bushels of plums, at \$$1\frac{2}{3}$ a bushel?

22. If one bushel of wheat is worth $2\frac{4}{5}$ bushels of oats, how many bushels of oats should be given for $3\frac{3}{4}$ bushels of wheat?

23. If a carpenter earns $\frac{7}{9}$ of \$$22\frac{1}{2}$ a week, and saves $\frac{3}{10}$ of it, what will he save each week?

24. Jesse picked $\frac{5}{7}$ of $8\frac{3}{4}$ quarts of berries, and sold $\frac{3}{5}$ of them. How many quarts did he sell?

25. A barrel of cider contained $31\frac{1}{2}$ gallons, and $\frac{2}{9}$ of

it was sold at 20 cents a gallon. How much was received for it?

26. How far could a man walk in $3\frac{1}{8}$ days, of $7\frac{1}{2}$ hours each, at the rate of 4 miles an hour?

27. A farmer having $18\frac{3}{4}$ barrels of apples, exchanged $\frac{2}{3}$ of them for coal, at the rate of $\frac{2}{5}$ tons for 1 barrel of apples. How many tons did he receive?

28. $4\frac{1}{2}$ pieces of cloth, each measuring $6\frac{2}{3}$ yards, were sold at $\$1\frac{1}{4}$ a yard. How much was paid for the cloth?

29. Two men travel in opposite directions, one going $3\frac{3}{4}$ miles an hour, the other $3\frac{1}{2}$ miles an hour. How far apart will they be in 10 hours?

30. If a laborer can dig $22\frac{1}{2}$ cubic feet of ditch in 1 hour, how many cubic feet can 3 laborers dig in $2\frac{2}{9}$ hours?

31. If a bushel of strawberries is worth $2\frac{1}{4}$ bushels of pears, and a bushel of pears is worth $2\frac{1}{2}$ bushels of apples, how many bushels of apples should be given for $2\frac{2}{3}$ bushels of strawberries?

32. Walter is $15\frac{3}{4}$ years old. Jasper's age is $\frac{7}{9}$ of Walter's, and Oliver's is $\frac{6}{7}$ of Jasper's. What are the ages of Jasper and Oliver?

33. A farmer sold $6\frac{1}{4}$ loads of straw, each weighing $1\frac{1}{5}$ tons, at $\$4\frac{2}{5}$ a ton. What did he receive for his straw?

34. A owns $33\frac{1}{3}$ acres of land, B owns $\frac{4}{5}$ as much as A, and C owns $\frac{3}{4}$ as much as B. How many acres do all own?

35. A coat cost $\$24\frac{1}{2}$, a pair of pants, $\frac{3}{7}$ as much as the coat, and the vest cost $\frac{10}{21}$ as much as the pants. What was the cost of the suit?

LESSON XXV.

There are two methods of dividing a fraction by a fraction.

The first method is to reduce both fractions to a common denominator, and then *divide the numerator of the dividend by the numerator of the divisor.* The other method is *to invert the fractional divisor, and multiply the dividend by it.* The student should be thoroughly drilled upon the first method, and, in reviews, permitted to exercise his judgment as to which method to adopt.

1. Divide $\frac{2}{3}$ by $\frac{1}{2}$.

1*st Solution:* The common denominator is 6; $\frac{2}{3}$ are $\frac{4}{6}$; $\frac{1}{2}$ is $\frac{3}{6}$; $\frac{3}{6}$ are contained in $\frac{4}{6}$ as often as 3 are contained in 4, which is $\frac{4}{3}$ times, $= 1\frac{1}{3}$. *Answer:* $1\frac{1}{3}$ times.

2*d Solution:* The divisor inverted is $\frac{2}{1}$. Then, $\frac{2}{3} \times \frac{2}{1} = \frac{4}{3}, = 1\frac{1}{3}$.

2. Divide $\frac{3}{4}$ by $\frac{1}{3}$; $\frac{2}{5}$ by $\frac{1}{4}$; $\frac{3}{5}$ by $\frac{1}{3}$; $\frac{2}{3}$ by $\frac{1}{5}$.
3. Divide $\frac{1}{3}$ by $\frac{2}{5}$; $\frac{1}{4}$ by $\frac{2}{3}$; $\frac{1}{5}$ by $\frac{3}{4}$; $\frac{1}{2}$ by $\frac{4}{5}$.
4. Divide $\frac{5}{6}$ by $\frac{1}{3}$; $\frac{1}{6}$ by $\frac{3}{4}$; $\frac{4}{7}$ by $\frac{1}{2}$; $\frac{1}{3}$ by $\frac{5}{8}$.
5. Divide $\frac{2}{3}$ by $\frac{3}{5}$; $\frac{3}{4}$ by $\frac{2}{3}$; $\frac{4}{5}$ by $\frac{3}{4}$; $\frac{5}{6}$ by $\frac{4}{5}$.
6. Divide $\frac{3}{7}$ by $\frac{2}{3}$; $\frac{5}{8}$ by $\frac{4}{5}$; $\frac{2}{9}$ by $\frac{3}{5}$; $\frac{3}{10}$ by $\frac{4}{7}$.
7. Divide $\frac{7}{8}$ by $\frac{3}{4}$; $\frac{5}{9}$ by $\frac{3}{5}$; $\frac{7}{10}$ by $\frac{2}{3}$; $\frac{3}{8}$ by $\frac{2}{5}$.
8. Divide $\frac{3}{4}$ by $\frac{8}{9}$; $\frac{9}{10}$ by $\frac{2}{3}$; $\frac{8}{11}$ by $\frac{3}{4}$; $\frac{5}{12}$ by $\frac{2}{5}$.
9. Divide $\frac{7}{12}$ by $\frac{3}{5}$; $\frac{5}{8}$ by $\frac{7}{10}$; $\frac{5}{9}$ by $\frac{5}{6}$; $\frac{4}{7}$ by $\frac{2}{3}$.
10. Divide $\frac{9}{20}$ by $\frac{3}{5}$; $\frac{5}{18}$ by $\frac{8}{9}$; $\frac{2}{3}$ by $\frac{4}{15}$; $\frac{14}{15}$ by $\frac{7}{9}$.
11. Divide $\frac{6}{5}$ by $\frac{3}{8}$; $\frac{10}{3}$ by $\frac{5}{12}$; $\frac{9}{8}$ by $\frac{3}{4}$; $\frac{12}{7}$ by $\frac{14}{15}$.
12. Divide $\frac{10}{7}$ by $\frac{7}{10}$; $\frac{9}{5}$ by $\frac{3}{2}$; $\frac{15}{8}$ by $\frac{2}{3}$; $\frac{12}{5}$ by $\frac{8}{3}$.
13. At \$$\frac{4}{5}$ a bushel, what part of a bushel of apples can be bought for \$$\frac{3}{4}$?
14. If $\frac{2}{3}$ of a yard of velvet is worth $\frac{8}{9}$ of a yard of silk, what part of a yard of velvet is worth 1 yard of silk?
15. If $\frac{3}{8}$ of a gallon of cider is worth $\frac{9}{10}$ of a pound of butter, how much cider is worth 1 pound of butter?

16. At $\$\frac{4}{5}$ a pound, how much tobacco can be bought for $\$\frac{7}{10}$?

17. If a man can build $\frac{5}{8}$ of a rod of fence in $\frac{3}{4}$ of an hour, how much can he build in 1 hour?

18. Exchanged $\frac{9}{16}$ of a bushel of corn for $\frac{3}{8}$ of a bushel of wheat. How much wheat should be given for 1 bushel of corn?

19. If one dozen of eggs cost $\$\frac{3}{20}$, how many dozen will cost $1?

20. If $\frac{3}{10}$ of a barrel of apples cost $\$\frac{9}{20}$, what will 1 barrel cost?

LESSON XXVI.

1. $2\frac{2}{5}$ are what part of 4?

Solution: $2\frac{2}{5} = \frac{12}{5}$. $\frac{12}{5} \div 4 = \frac{3}{5}$. *Answer:* $\frac{3}{5}$ of 4.

2. $3\frac{1}{3}$ are what part of 5? $6\frac{1}{4}$ are what part of 10?

3. $3\frac{3}{5}$ are what part of 9? $7\frac{1}{2}$ are what part of 12?

4. $8\frac{1}{3}$ are what part of 15? $6\frac{3}{4}$ are what part of 18?

5. $4\frac{4}{9}$ are what part of 10? $7\frac{1}{5}$ are what part of 12?

6. $3\frac{3}{4}$ are what part of 9? $12\frac{1}{2}$ are what part of 20?

7. $5\frac{2}{5}$ are what part of 18? $9\frac{1}{3}$ are what part of 14?

8. $5\frac{5}{9}$ are what part of 25? $6\frac{7}{8}$ are what part of 11?

9. $7\frac{3}{7}$ are what part of 13? $10\frac{2}{3}$ are what part of 12?

10. $9\frac{4}{5}$ are what part of 14? $8\frac{1}{3}$ are what part of 20?

11. What part is $\frac{3}{5}$ of $\frac{4}{3}$? What part is $\frac{5}{8}$ of $\frac{6}{5}$?

12. What part is $\frac{3}{10}$ of $\frac{5}{9}$? What part is $\frac{5}{12}$ of $\frac{3}{7}$?

13. What part is $\frac{4}{5}$ of $\frac{7}{8}$? What part is $\frac{5}{9}$ of $\frac{5}{8}$?

14. What part is $\frac{7}{10}$ of $\frac{8}{9}$? What part is $\frac{5}{6}$ of $\frac{9}{10}$?

15. What part is $\frac{9}{16}$ of $\frac{4}{5}$? What part is $\frac{8}{15}$ of $\frac{2}{3}$?

16. What part of $4\frac{1}{2}$ is $3\frac{3}{8}$? What part of $5\frac{5}{8}$ is $3\frac{3}{4}$?

17. What part of $5\frac{1}{3}$ is $1\frac{3}{5}$? What part of $6\frac{2}{3}$ is $3\frac{3}{4}$?

18. What part of $3\frac{3}{5}$ is $2\frac{1}{4}$? What part of $8\frac{8}{9}$ is $6\frac{2}{3}$?

19. What part of $12\frac{1}{2}$ is $8\frac{1}{3}$? What part of $18\frac{3}{4}$ is $7\frac{1}{2}$?

20. What part of $22\frac{1}{2}$ is $6\frac{3}{4}$? What part of $33\frac{1}{3}$ is $6\frac{1}{4}$?

NOTE.—*In all questions like the preceding it is interesting to know that the number following the preposition* of *is always the divisor.*

21. A grocer bought 6 barrels of sugar, and afterward sold $2\frac{2}{3}$ barrels. What part of his sugar did he sell?

Solution: He sold such a part of it as $2\frac{2}{3}$ barrels are part of 6 barrels, which is $\frac{8}{3} \div 6 = \frac{4}{9}$ *Answer:* $\frac{4}{9}$ of it.

22. A farmer owning 12 tons of hay, sold $7\frac{1}{2}$ tons. What part of the hay was sold?

23. Having a quantity of wool worth $15, I sold a part of it for $4½. What part of the wool did I sell?

24. If a traveler can complete a journey in $3\frac{3}{5}$ days, what part of it can he perform in 2 days?

25. If a machine can cut $10\frac{2}{3}$ acres of clover in a day, in what part of a day could it cut 6 acres?

26. A barrel contained 36 gallons of oil, but $22\frac{1}{2}$ gallons were drawn off. What part of the oil was drawn off.

27. A farmer owning $37\frac{1}{2}$ acres of land, gave 15 acres to his son. What part of the land did the son receive?

28. A merchant having a quantity of bacon worth $14⅖, sold some of it for $9. What part of the bacon was sold?

29. A man having $26\frac{2}{3}$ miles to travel, went 12 miles in the morning, and the remainder in the afternoon. What part of the distance did he travel in the morning?

30. Owning $18\frac{3}{4}$ bushels of wheat, I sold $12\frac{1}{2}$ bushels. What part of the wheat was sold?

31. Having $24\frac{3}{4}$ cords of wood, I sold $5\frac{1}{2}$ cords. What part of the wood did I sell?

32. If a laborer can do a piece of work in $16\frac{2}{3}$ days, what part of it can he do in $6\frac{1}{4}$ days?

33. A mason agreed to build $12\frac{1}{4}$ rods of wall, but completed only $10\frac{1}{2}$ rods. What part of the wall was completed?

34. I bought a cow for \$$19\frac{1}{5}$, but paid only \$12. What part of the price was paid?

35. A tailor bought $9\frac{3}{8}$ yards of cloth, and afterward sold $2\frac{1}{2}$ yards. What part of the cloth did he sell?

LESSON XXVII.

1. How often is $\frac{2}{3}$ contained in $\frac{4}{5}$? in $\frac{3}{4}$? in $\frac{5}{6}$?
2. How often is $\frac{5}{8}$ contained in $\frac{2}{3}$? in $\frac{15}{16}$? in $\frac{25}{12}$?
3. How often is $\frac{7}{8}$ contained in $2\frac{4}{5}$? in $2\frac{5}{8}$? in $3\frac{1}{2}$?
4. How often is $\frac{4}{9}$ contained in $3\frac{1}{3}$? in 6? in $2\frac{2}{3}$?
5. How often is $\frac{9}{10}$ contained in $4\frac{1}{2}$? in $3\frac{3}{5}$? in $6\frac{3}{4}$?
6. How often is $\frac{4}{3}$ contained in $2\frac{4}{9}$? in $2\frac{5}{6}$? in $4\frac{4}{5}$?
7. How often is $2\frac{1}{2}$ contained in $\frac{3}{4}$? in $\frac{4}{5}$? in $\frac{5}{6}$?
8. How often is $3\frac{1}{3}$ contained in $\frac{5}{9}$? in $\frac{5}{8}$? in $\frac{20}{21}$?
9. How often is $4\frac{1}{2}$ contained in $\frac{15}{16}$? in $\frac{6}{5}$? in $\frac{18}{25}$?
10. How often is $6\frac{2}{3}$ contained in $\frac{5}{6}$? in $\frac{8}{9}$? in $\frac{10}{21}$?
11. How often is $6\frac{1}{4}$ contained in $\frac{5}{8}$? in $\frac{15}{16}$? in $\frac{25}{32}$?
12. How often is $3\frac{3}{4}$ contained in $12\frac{1}{2}$? in $16\frac{2}{3}$? in $18\frac{3}{4}$?

13. $5\frac{5}{9}$ are $\frac{1}{3}$ of what number? $6\frac{3}{4}$ are $\frac{1}{8}$ of what number?

14. $6\frac{2}{3}$ are $\frac{1}{5}$ of what number? $4\frac{4}{5}$ are $\frac{1}{10}$ of what number?

15. $7\frac{1}{5}$ are $\frac{3}{4}$ of what number? $8\frac{8}{9}$ are $\frac{4}{5}$ of what number?

16. $9\frac{3}{5}$ are $\frac{8}{9}$ of what number? $10\frac{2}{3}$ are $\frac{4}{9}$ of what number?

17. $11\frac{1}{9}$ are $\frac{10}{3}$ of what number? $8\frac{4}{5}$ are $\frac{11}{12}$ of what number?

18. $18\frac{3}{4}$ are $\frac{5}{4}$ of what number? $17\frac{1}{2}$ are $\frac{7}{5}$ of what number?

19. $16\frac{2}{3}$ are $\frac{10}{7}$ of what number? $9\frac{1}{11}$ are $\frac{5}{8}$ of what number?

20. $5\frac{5}{8}$ are $\frac{15}{16}$ of what number? $6\frac{6}{7}$ are $\frac{24}{25}$ of what number?

21. A tailor made 7 coats, exactly alike, out of $25\frac{2}{3}$ yards of cloth. How many yards were required for each coat?

22. Five boys gathered $8\frac{3}{4}$ bushels of walnuts, which they divided equally. What was each one's share?

23. A mechanic earned $\$15\frac{3}{5}$ in 6 days. How much was that per day?

24. $18\frac{3}{4}$ bushels of coal was divided equally among 5 poor persons. What did each receive?

25. $26\frac{2}{3}$ rods of fence were built by 4 men. How many rods did each build?

26. A man walked $22\frac{1}{2}$ miles in 6 hours. How far did he walk per hour?

27. A's age is 42 years, which is $1\frac{3}{4}$ times B's age. How old is B?

28. Edwin has 28 marbles, which is $2\frac{1}{3}$ times as many as Alfred has. How many has Alfred?

29. A farmer owns 60 sheep, which is $1\frac{5}{7}$ times the number of his hogs. How many hogs does he own?

30. If $6\frac{1}{4}$ tons of hay cost $75, what is the value of 1 ton?

31. A horse can trot 60 miles in $6\frac{2}{3}$ hours. How far can he trot in 1 hour?

32. If a mechanic can earn $\$16\frac{1}{2}$ in 6 days, how much can he earn in 1 day?

33. There are $5\frac{1}{2}$ yards in 1 rod. How many rods are in $30\frac{1}{4}$ yards?

34. A vessel containing $31\frac{1}{2}$ gallons was emptied by a pipe in $2\frac{1}{4}$ minutes. How many gallons were discharged per minute?

35. A tract of land containing 18¾ acres was divided into lots each containing ⅜ of an acre. How many lots were there?

36. If 3¾ dozen eggs cost 60 cents, what is the cost per dozen?

37. The product of two numbers is 37½. If 8⅓ is one of them, what is the other?

38. Victor earned $5⅗ in 4⅔ days. How much did he earn daily?

39. A family consumed 12 pounds of beef in 2⅔ days. What was its daily allowance?

40. 3⅗ acres of meadow yielded 6¾ tons of hay. What was the yield per acre?

41. A certain fraction multiplied by 16⅔ equals 8. What is the fraction?

42. A laborer built 30 rods of fence in 5⅖ days. How many rods did he build daily?

43. 9⅓ yards of cloth cost $21. What was the cost per yard?

44. If a bushel of wheat is worth 1¾ bushels of barley, how many bushels of wheat should be given for 17½ bushels of barley?

45. If it cost 8⅓ cents to ride 1 mile, how far could I ride for 40 cents?

46. A farmer planted 5⅝ acres in corn, which was 2¼ times what he planted in potatoes. How many acres in potatoes?

47. 40½ yards of cloth were made into suits, each containing 6¾ yards. How many suits were made?

48. A machinist earned $42 in 10½ days of 10 hours each. How much was that per hour?

49. There are twenty pennyweights in an ounce. If 3⅓ ounces of refined gold are worth $80, what is the value of 1 pennyweight?

50. Paid \$21 for $4\frac{2}{3}$ dozen silk handkerchiefs. How much was that *apiece?*

LESSON XXVIII.

1. In an orchard are 16 pear trees, which is $\frac{4}{9}$ of the number of apple trees. How many apple trees are there?

2. Paid \$42 for a cow, which was $\frac{7}{5}$ of her value. What was her value?

3. The distance from A to B is 15 miles, which is $\frac{5}{7}$ of the distance from C to D. How far is it from C to D?

4. A farmer sold 36 bushels of corn, which was $\frac{9}{8}$ of what he had remaining. How many bushels remained?

5. A boy spent 48 cents, which was $\frac{8}{15}$ of all his money. How much had he at first?

6. A telegraph pole stands $\frac{9}{11}$ in the air, and 6 feet in the ground. How long is the pole?

7. A lady bought a certain quantity of ribbon. After using $\frac{4}{7}$ of it, there remained 9 yards. How many yards did she buy?

8. Mr. Jones bought a buggy. After paying $\frac{7}{10}$ of the price, he owed \$30. How much did he pay?

9. A man sold $\frac{5}{12}$ of his land, and had 56 acres remaining. How many acres did he sell?

10. A's age is 21 years, and $\frac{5}{7}$ of his age is $\frac{3}{5}$ of B's. How old is B?

11. A trader having \$80, gave $\frac{9}{16}$ of it for sheep, at \$3 each. How many sheep did he buy?

12. A watch cost \$72, and $\frac{4}{9}$ of the cost of the watch equaled $\frac{8}{7}$ of the cost of the chain. What was the total cost of watch and chain?

13. If $\frac{3}{8}$ of a book contains 75 pages, and I read 20 pages a day, in how many days can I read the book?

14. Daniel walked 14 miles, and $\frac{5}{7}$ of the distance he walked was $\frac{2}{3}$ of the distance that David walked. How much farther did David walk than Daniel?

15. A parlor contains 40 yards of carpet, and $\frac{7}{10}$ of the number of yards in the parlor $= \frac{4}{5}$ of the number in the dining-room. How many yards in both rooms?

16. Sold a carriage for $120, which was $\frac{6}{5}$ of the cost. I paid for it with apples, at $4 a barrel. How many barrels did I give?

17. Sold a horse for $81, which was $\frac{9}{11}$ of the cost. Paid for him with wood, at $6 a cord. How many cords were required?

18. $\frac{9}{16}$ of 64 are what part of $\frac{5}{11}$ of 99?

19. If you have 45 cents, and $\frac{4}{5}$ of your money $= \frac{6}{7}$ of mine, how much have I?

20. A jockey sold a horse for $63, and gained $\frac{2}{7}$ of the cost. How much did he gain?

21. If $3\frac{1}{2}$ bushels of apples make $5\frac{1}{4}$ gallons of cider, how many gallons could be made from 10 bushels?

22. If $\frac{5}{6}$ of a yard of silk cost $\$\frac{3}{4}$, what would 9 yards cost?

23. If $\frac{5}{9}$ of a ton of hay cost $\$8\frac{1}{3}$, how many tons would cost $50?

24. Bought 24 sheep, at $\$3\frac{1}{8}$ each, but 4 having died, at what price per head must I sell the remainder to sustain no loss?

25. If a man can build a wall in $6\frac{2}{3}$ days by working 9 hours a day, how long will it take him if he works 8 hours a day?

26. $\frac{5}{7}$ of 56 are $\frac{8}{9}$ of how many times 3?

27. By selling a lot of goods for $33 I made $\frac{2}{9}$ of the cost. I paid for them with apples at $\$\frac{1}{2}$ a bushel. How many bushels were required?

28. If a man travel 24 miles in $2\frac{2}{5}$ hours, how far will he travel in $\frac{3}{4}$ hour?

29. A stick of timber stands $\frac{9}{11}$ in the air, and 5 feet in the ground. How long is the stick?

30. $\frac{3}{4}$ of a yard of cloth cost $2. At the same rate what will $\frac{9}{10}$ yard cost?

31. A man can perform a journey in $5\frac{3}{5}$ days. What part of it can he perform in $3\frac{1}{2}$ days?

32. A horse cost $60. $\frac{7}{12}$ of the price of the horse = $\frac{5}{7}$ of the price of the buggy. What did the buggy cost?

33. If $\frac{8}{9}$ of a yard of velvet cost $4, how many yards will cost $20?

34. If 6 men can do a piece of work in 4 days, in how many days can 8 men do a piece half as large?

35. If a laborer can earn $$7\frac{1}{2}$ in $3\frac{1}{3}$ days, how much can he earn in 8 days?

36. Bought $2\frac{1}{3}$ dozen handkerchiefs for $$10\frac{1}{2}$. How much did one handkerchief cost?

37. $\frac{5}{8}$ of $10\frac{2}{3}$ are $\frac{4}{5}$ of how many times 5?

38. Bought 12 barrels of flour for $48, and sold $\frac{2}{3}$ of them for $40. How much per barrel was gained on the part sold?

39. If $\frac{5}{8}$ of a yard of cloth cost $$3\frac{1}{3}$, what would $4\frac{1}{2}$ yards cost?

40. C can earn $$18\frac{3}{4}$ in 5 days of 10 hours each. How much can he earn in 12 days of 8 hours each?

41. A travels 46 miles in $3\frac{5}{6}$ hours. How far can he travel in $8\frac{1}{4}$ hours?

42. If $8\frac{2}{5}$ is $4\frac{2}{3}$ times a certain number, what is 10 times the same number?

43. A plows $4\frac{1}{2}$ acres, while B plows $3\frac{3}{5}$ acres. How many acres will B have finished when A has plowed $7\frac{1}{2}$ acres?

44. A man owning $\frac{4}{5}$ of a boat, sold $\frac{2}{3}$ of his share for $400. At that rate, what was the value of the boat?

45. John's age is 18 years, which is $\frac{3}{7}$ of the age of

his father. The father is 14 times as old as his youngest son. How old are the father and the youngest son?

46. Sold a horse for \$63, and lost $\frac{4}{25}$ of the cost. What part of the cost would I have gained had I sold him for \$100?

47. If $\frac{7}{8}$ of a barrel of flour cost \$$4\frac{1}{5}$, how many barrels would cost \$24?

48. Seven ninths of $7\frac{1}{5}$ are $\frac{4}{7}$ of how many times 2?

49. A pair of pants cost \$6, which was $\frac{3}{8}$ of the cost of a coat. The vest cost $\frac{2}{3}$ as much as the pants. What was the cost of the suit?

50. A grocer sold $\frac{7}{9}$ of a barrel of cider, and had 7 gallons left. How many gallons did the barrel contain?

51. By selling a lot of groceries for \$36, I made $\frac{2}{7}$ of the cost. I paid for them with potatoes at \$$\frac{4}{5}$ a bushel. How many bushels were required?

52. If $8\frac{3}{4}$ is $3\frac{1}{2}$ times a certain number, what is $2\frac{2}{5}$ times the same number?

53. A traveled 57 miles in $3\frac{4}{5}$ hours. At that rate how far could he travel in $6\frac{2}{3}$ hours?

54. Bought a wagon for \$81, which was $\frac{9}{8}$ of its value. I sold it for $\frac{5}{6}$ of its value. What did I receive for it?

55. Seven eighths of $9\frac{3}{5}$ are $\frac{6}{10}$ of how many times 4?

56. Sold 12 barrels of apples for \$35, and lost $\frac{1}{6}$ of the cost. What did 5 barrels cost?

57. 12 of my sheep died, which was $\frac{3}{7}$ of what I had remaining. If I paid \$$3\frac{3}{4}$ apiece for them, what did the entire flock cost?

Review.

LESSON XXIX.

1. A jeweler bought $5\frac{1}{4}$ ounces of gold at one time, and $4\frac{2}{5}$ ounces at another. After using $7\frac{7}{10}$ ounces, how much remained?

2. Paid \$$6\frac{1}{4}$ for potatoes, at \$$\frac{2}{3}$ a bushel. How many bushels were bought?

3. Bought lemons at 4 for 5 cents, and sold them at 5 for 4 cents. How much did I lose on 20 lemons?

4. 63 is $\frac{9}{7}$ of how many times 5? $\frac{9}{7}$ of 84 are how many times 11?

5. $\frac{1}{8}$ of a certain number is 5 more than $\frac{4}{7}$ of 21. What is the number?

6. $\frac{4}{9}$ of 45 are 10 less than $\frac{5}{8}$ of how many times 3?

7. $9\frac{3}{5}$ are $\frac{8}{9}$ of what number? $5\frac{3}{5}$ are how many times 7?

8. If $\frac{5}{8}$ of a yard of cloth cost \$$\frac{3}{4}$, how many yards will cost \$12?

9. A pole 25 feet long is $\frac{2}{9}$ in the earth, the rest in the air. How long is each part?

10. If $\frac{3}{4}$ of the gain $= \frac{6}{25}$ of the cost, for how much should a wagon be sold that cost \$75?

11. After spending $\frac{3}{8}$ and $\frac{1}{4}$ of my money, and giving away $\frac{1}{12}$ of it, I had \$35 remaining. How much did I spend?

12. A can do a piece of work in 12 days, B in 8 days, C in 6 days. In what time can all do the work?

13. Having \$$37\frac{1}{2}$, I gave $\frac{2}{5}$ of it for a stove, $\frac{4}{9}$ of the remainder for carpet, and the balance for a lounge. What was the cost of each?

14. $\frac{4}{5}$ of 10 are what part of twice that number of which 28 is $\frac{7}{9}$?

15. Bought a watch for \$56, which was $\frac{1}{6}$ more than its value. I sold it for $\frac{7}{8}$ of its value. How much did I lose?

16. If $5\frac{1}{3}$ is $1\frac{3}{5}$ times a certain number, what is $4\frac{1}{2}$ times the number?

17. A sold B a gun for \$50, and gained $\frac{1}{4}$ of the cost. B then sold it, and lost $\frac{3}{10}$ of what it cost him. How much more did B lose than A gained?

18. C traveled 38 miles in $2\frac{3}{8}$ hours. At the same rate how far could he have traveled in $6\frac{1}{4}$ hours?

19. Four ninths of 54 are what part of $\frac{8}{11}$ of 88?

20. Sold a cow for \$$22\frac{1}{2}$, thereby losing $\frac{2}{11}$ of the cost. For how much should I have sold her to gain \$$7\frac{1}{2}$?

21. A can do a piece of work in 3 days, B in 4 days, C in 6 days. In what time can they complete it by working together?

22. After spending $\frac{1}{4}$ and $\frac{3}{8}$ of my money, and losing $\frac{1}{6}$ of it, I had \$15 remaining. How much had I at first?

23. Bought wheat at 5 bushels for \$4, and sold it at the rate of 4 bushels for \$5. How much did I gain on 40 bushels?

24. John lost $\frac{3}{10}$ of his marbles; he gave $\frac{2}{7}$ of the remainder to his brother, who received 20 marbles. How many had John at first?

25. If $7\frac{1}{2}$ is $1\frac{2}{3}$ times a certain number, what is $2\frac{1}{4}$ times the number?

26. If $\frac{3}{5}$ of a bushel of clover-seed cost \$2, what part of a bushel will cost \$3?

27. Sold 15 oranges for 51 cents, thereby losing $\frac{3}{20}$ of the cost. If, in selling them, I had gained $\frac{1}{4}$ of the cost, what would I have received for each orange?

28. A lady purchased $4\frac{5}{6}$ yards of muslin at one store, and $5\frac{3}{4}$ yards at another. After using $7\frac{2}{3}$ yards, how much remained?

29. If a laborer can do a certain work in $13\frac{3}{4}$ days, what part of it can he do in $9\frac{5}{8}$ days?

30. By selling a horse for $85 I made $\frac{2}{15}$ of the cost. I paid for him with wheat at $\$\frac{3}{4}$ a bushel. How many bushels were required?

31. Three men divided $\$37\frac{1}{2}$, A taking $\frac{2}{5}$, B $\frac{1}{3}$, C the remainder. How much did each take?

32. A owns $18\frac{3}{4}$ acres of land, and B owns $11\frac{1}{4}$ acres. If A should sell $\frac{1}{5}$ of his land to B, how many acres would each then own?

33. A can do a piece of work in 3 days, B in 4 days, C in 6 days. In what time could all do a piece twice as large?

34. A vest cost $\$4\frac{1}{2}$, which was $\frac{2}{9}$ of the cost of a coat. The pants cost twice as much as the vest. What was the cost of the suit?

35. If $\frac{5}{8}$ of a bushel of oats are worth $\frac{3}{4}$ of a bushel of corn, how many bushels of corn should be given for $6\frac{1}{4}$ bushels of oats?

36. I allowed my agent $\frac{3}{20}$ of all collections. If he received $\$7\frac{1}{2}$ dollars, how much did I get?

37. A pole 33 feet long is $\frac{2}{9}$ in the ground, the rest in the air. How long is each part?

38. Spent $\frac{3}{8}$ of my money for a horse, $\frac{3}{10}$ of it for a buggy, $\frac{1}{5}$ of it for a set of harness, and had $25 remaining. Find the cost of horse, buggy, and harness.

39. B's watch cost $35, and his chain $18. $\frac{6}{7}$ of the price of the watch $+ \frac{5}{6}$ that of the chain $= \frac{9}{11}$ of the cost of his suit of clothes. What did the suit cost?

40. From the sum of $3\frac{4}{5}$ and $2\frac{1}{2}$ take their difference?

41. Owning 50 acres of land, I planted $10\frac{5}{8}$ acres in corn, $9\frac{3}{10}$ acres in potatoes, $13\frac{3}{4}$ acres in wheat, and the remainder in barley. How many acres were planted in barley?

42. A sold B a buggy, and gained $\frac{1}{4}$ of the cost. B sold it for \$75, and lost $\frac{1}{4}$ of what he paid for it. How much did the buggy cost A?

43. C can build a fence in $6\frac{2}{5}$ days. What part of it can he build in $2\frac{2}{3}$ days?

44. The difference between $\frac{5}{7}$ and $\frac{3}{5}$ of Leslie's money is \$$2\frac{2}{5}$. How much has he?

45. Mary's age is 9 years, which is $\frac{3}{8}$ of Jennie's, and $\frac{9}{11}$ of the sum of their ages is $\frac{3}{2}$ of the age of their brother Henry. How old is Henry?

46. James can earn \$$21\frac{3}{5}$ in 12 days, of 9 hours each? How much can he earn in 15 days, of 8 hours each?

47. A can do a piece of work in 5 days, B in 6 days, C in 10 days, D in 15 days. In what time can all do a piece 4 times as large?

48. If Joe travels 54 miles in $6\frac{3}{4}$ hours, and Tom travels 36 miles in $3\frac{3}{5}$ hours, how much farther will Tom travel than Joe in $12\frac{1}{2}$ hours?

49. If a man can do a piece of work in $8\frac{8}{9}$ days, by working 9 hours a day, how much longer would it take him if he worked but $6\frac{2}{3}$ hours a day?

50. A and B travel in the same direction, A being 25 miles ahead. If B travels 10 miles an hour, and A $\frac{3}{4}$ as fast, in how many hours will B overtake him?

51. To the sum of $3\frac{5}{6}$ and $2\frac{3}{4}$ add their difference?

52. A man owning $\frac{5}{8}$ of a farm, sold $\frac{3}{5}$ of his share for \$600. What was the value of the whole farm, and of his remaining interest?

LESSON XXX.

The following table of fractional parts of 100 will be found useful in the solution of many kinds of problems involving business transactions.

FRACTIONAL PARTS OF 100.

$2 = \frac{1}{50}$
$3\frac{1}{3} = \frac{1}{30}$
$4 = \frac{1}{25}$
$5 = \frac{1}{20}$
$6\frac{1}{4} = \frac{1}{16}$
$6\frac{2}{3} = \frac{1}{15}$
$8\frac{1}{3} = \frac{1}{12}$

$10 = \frac{1}{10}$
$11\frac{1}{9} = \frac{1}{9}$
$12\frac{1}{2} = \frac{1}{8}$
$14\frac{2}{7} = \frac{1}{7}$
$15 = \frac{3}{20}$
$16\frac{2}{3} = \frac{1}{6}$
$18\frac{3}{4} = \frac{3}{16}$

$20 = \frac{1}{5}$
$25 = \frac{1}{4}$
$26\frac{2}{3} = \frac{4}{15}$
$30 = \frac{3}{10}$
$31\frac{1}{4} = \frac{5}{16}$
$33\frac{1}{3} = \frac{1}{3}$
$37\frac{1}{2} = \frac{3}{8}$

$40 = \frac{2}{5}$
$50 = \frac{1}{2}$
$56\frac{1}{4} = \frac{9}{16}$
$60 = \frac{3}{5}$
$62\frac{1}{2} = \frac{5}{8}$
$75 = \frac{3}{4}$
$87\frac{1}{2} = \frac{7}{8}$

1. Multiply 16 by $87\frac{1}{2}$.

Solution: $87\frac{1}{2} = \frac{7}{8}$ of 100, or $\frac{700}{8}$; $16 \times \frac{700}{8} = 1400$. *Answer:* 1400.

2. Divide 375 by $18\frac{3}{4}$.

Solution: $18\frac{3}{4} = \frac{3}{16}$ of 100, or $\frac{300}{16}$; $375 \div \frac{300}{16} = 375 \times \frac{16}{300} = 20$. *Answer:* 20.

3. Multiply 27 by $3\frac{1}{3}$; 48 by $6\frac{1}{4}$; 45 by $6\frac{2}{3}$.
4. Multiply 36 by $11\frac{1}{9}$; 32 by $12\frac{1}{2}$; 28 by $14\frac{2}{7}$.
5. Multiply 42 by $16\frac{2}{3}$; 64 by $18\frac{3}{4}$; 56 by 25.
6. Multiply 75 by $26\frac{2}{3}$; 48 by $31\frac{1}{4}$; 33 by $33\frac{1}{3}$.
7. Multiply 56 by $37\frac{1}{2}$; 32 by $56\frac{1}{4}$; 64 by $62\frac{1}{2}$.
8. Divide 120 by $3\frac{1}{3}$; 150 by $6\frac{1}{4}$; 180 by $6\frac{2}{3}$.
9. Divide 500 by $11\frac{1}{9}$; 225 by $12\frac{1}{2}$; 700 by $14\frac{2}{7}$.
10. Divide 450 by $16\frac{2}{3}$; 800 by $26\frac{2}{3}$; 375 by $31\frac{1}{4}$.
11. Divide 1200 by $33\frac{1}{3}$; 1300 by 25; 525 by $37\frac{1}{2}$.
12. Divide 450 by $56\frac{1}{4}$; 1750 by $62\frac{1}{2}$; 1050 by $87\frac{1}{2}$.
13. What will 32 yards of carpet cost at $87\frac{1}{2}$ cents a yard?

Solution: $87\frac{1}{2}$ cents $= \frac{7}{8}$ of a dollar; 32 yards will cost 32 times $\$\frac{7}{8} = \$28$.

What will be the cost of

14. 15 quarts of berries at $3\frac{1}{3}$ cents a quart?
15. 16 yards of muslin at $6\frac{1}{4}$ cents a yard?
16. 45 papers of needles at $6\frac{2}{3}$ cents a paper?
17. 30 quarts of milk at $8\frac{1}{3}$ cents a quart?

18. 28 copybooks at $12\frac{1}{2}$ cents apiece?

19. 27 ounces of snuff at $16\frac{2}{3}$ cents an ounce?

20. 32 pecks of apples at $18\frac{3}{4}$ cents a peck?

21. 18 pounds of coffee at $33\frac{1}{3}$ cents a pound?

22. 48 gallons of molasses at $37\frac{1}{2}$ cents a gallon?

23. 21 gross of pens at $66\frac{2}{3}$ cents a gross?

24. 18 bushels of corn at $62\frac{1}{2}$ cents a bushel?

25. 56 bottles of wine at $87\frac{1}{2}$ cents a bottle?

26. 36 geographies at $83\frac{1}{3}$ cents apiece?

27. 24 pairs of shoes at \$$1.12\frac{1}{2}$ a pair?

28. 30 bushels of peaches at \$$1.16\frac{2}{3}$ a bushel?

29. 33 yards of carpet at \$$1.33\frac{1}{3}$ a yard?

30. 12 barrels of potatoes at \$$1.66\frac{2}{3}$ a barrel?

31. 45 tons of coal at \$$3.33\frac{1}{3}$ a ton?

32. If I pay \$$8\frac{1}{4}$ for flannel, at $37\frac{1}{2}$ cents a yard, how many yards would I receive?

Solution: $37\frac{1}{2}$ cents are $\frac{3}{8}$ of a dollar. I would receive as many yards as $\frac{3}{8}$ are contained in \$$8\frac{1}{4}$, which is 22 times. *Answer:* 22 yards.

33. Paid \$1 for oranges, at $3\frac{1}{3}$ cents apiece. How many did I buy?

34. At $6\frac{1}{4}$ cents a pound, how many pounds of starch will cost \$$1\frac{1}{2}$?

35. Bought eggs for \$$1\frac{1}{5}$, at $6\frac{2}{3}$ cents a dozen. How many dozen did I buy?

36. Paid \$$3\frac{3}{4}$ for bacon, at $12\frac{1}{2}$ cents a pound. How many pounds did I buy?

37. At $16\frac{2}{3}$ cents a quire, how many quires of note paper will cost \$$2\frac{1}{2}$?

38. Bought delaine for \$$3\frac{3}{4}$, at $31\frac{1}{4}$ cents per yard. How many yards were bought?

39. How many bushels of oats, at $33\frac{1}{3}$ cents a bushel, can be bought for \$11?

40. If one handkerchief cost $37\frac{1}{2}$ cents, how many will cost *\$12?*

41. Paid $\$12\frac{1}{2}$ dollars for sirup, at $62\frac{1}{2}$ cents a gallon. How many gallons were bought?

42. If my house-rent is $66\frac{2}{3}$ cents a day, in what time will it amount to $40?

43. How many turkeys, at $87\frac{1}{2}$ cents apiece, will cost $21?

44. Paid $36 for books, at $\$1.12\frac{1}{2}$ each. How many did I buy?

45. Bought a quantity of wine for $\$10\frac{1}{2}$, at $\$1.16\frac{2}{3}$ a gallon. How many gallons were bought?

46. At $\$1.33\frac{1}{3}$ each, how many wall maps will cost $20?

47. If a dozen boxes of crayons cost $\$1.37\frac{1}{2}$, how many dozen boxes will cost $22?

48. Paid $25 for silk, at $\$1.66\frac{2}{3}$ a yard. How many yards did I buy?

49. How many barrels of apples, at $\$3.33\frac{1}{3}$ a barrel, will cost $100?

50. At $62\frac{1}{2}$ cents a pair, how many pairs of kid gloves will cost $\$18\frac{3}{4}$?

51. Bought $8\frac{1}{3}$ dozen knives, at $\$4\frac{4}{5}$ a dozen. What was the total cost? What did one knife cost?

Solution: They cost $8\frac{1}{3}$ times $\$4\frac{4}{5}$, or $\frac{25}{3}$ of $\$\frac{24}{5} = \$40$. One knife cost $\frac{1}{12}$ of $\$\frac{24}{5} = \$\frac{2}{5}$. *Answer:* $40 and $\$\frac{2}{5}$.

52. Bought $3\frac{1}{3}$ dozen books, at $\$4\frac{4}{5}$ a dozen, and sold them at $\$\frac{9}{20}$ apiece. Find the gain on one book. On the entire lot.

53. Bought $3\frac{3}{4}$ dozen silk handkerchiefs, at $\$7\frac{1}{5}$ a dozen, and sold them at $\$\frac{1}{2}$ apiece. How much did I lose by the sale?

54. Bought $6\frac{1}{4}$ dozen penholders, at $\$\frac{12}{25}$ a dozen, and sold them at $\$\frac{1}{20}$ apiece. What was my gain on the lot?

55. Bought $7\frac{1}{2}$ dozen boxes of colored crayons, at $\$2\frac{1}{2}$ a dozen, and sold them at $\$\frac{1}{4}$ a box. How much did *I gain?*

56. A merchant bought $6\frac{2}{3}$ dozen chairs, at $\$5$ a dozen, and sold them for $\$3\frac{1}{4}$ a set, or $\frac{1}{2}$ dozen. How much did he gain?

57. I gave $\$37\frac{1}{2}$ for $8\frac{1}{3}$ dozen plated spoons, and sold them at $\$3$ a set, or $\frac{1}{2}$ dozen. Find my gain.

58. Paid $\$33\frac{1}{3}$ for $3\frac{1}{3}$ dozen silver tea-spoons, and sold them at $\$4\frac{1}{2}$ a set. How much did I lose on the lot?

59. Paid $\$45$ for $7\frac{1}{2}$ dozen case-knives, and sold them for $\$3\frac{3}{4}$ a set. What was the entire profit?

60. Paid $\$18$ for $4\frac{1}{2}$ dozen handkerchiefs, and sold them for $\$\frac{3}{8}$ apiece. How much was gained?

61. Paid $\$9\frac{3}{5}$ for $5\frac{1}{3}$ dozen bottles of catsup, and sold them at $\$\frac{1}{5}$ per bottle. What was the gain?

62. Bought $3\frac{3}{4}$ dozen penknives for $\$13\frac{1}{2}$, and sold them for $\$\frac{2}{5}$ apiece. What was the profit on the lot?

63. Paid $\$10$ for $6\frac{2}{3}$ dozen cans of fruit, and sold them at $\$\frac{3}{20}$ a can. How much profit was made?

64. Paid $\$30$ for straw hats, at $\$8$ a dozen, and sold them at $\$\frac{4}{5}$ each. What was the entire profit?

65. A bookseller gave $\$22\frac{1}{2}$ for $3\frac{3}{4}$ dozen readers, and retailed them at $\$\frac{3}{5}$ apiece. How much did he gain on the lot?

66. Paid $\$28$ for brooms, at $\$4\frac{4}{5}$ a dozen, and sold them at $\$\frac{7}{20}$ each. What was the entire loss?

67. Bought 8 barrels of flour, at $\$3\frac{3}{4}$ a barrel, and 32 yards of cloth, at $62\frac{1}{2}$ cents a yard. Gave in exchange potatoes, at $\$\frac{2}{5}$ a bushel. How many bushels did I give?

68. If I buy 8 tons of coal, at $\$6.75$ a ton, and 63 pounds of coffee, at $33\frac{1}{3}$ cents a pound, how many bushels of apples, at 25 cents a bushel, should be given in exchange?

69. A merchant sold 12 boxes of canned fruit, at $\$3.75$ a box, and 80 pounds of sugar, at $6\frac{1}{4}$ cents a pound. He took in exchange potatoes, at $62\frac{1}{2}$ cents a bushel. How many *bushels* did he receive?

70. A merchant bought 7 tons of hay, at $12½ a ton, and 60 bushels of oats, at 62½ cents a bushel. He gave in exchange flour, at $5 a barrel. How many barrels were required?

71. Bought 8 barrels of flour, at $5.62½ a barrel, and 18 yards of cloth, at 83⅓ cents a yard. Gave in exchange potatoes, at $⅘ a bushel? How many bushels were required?

72. A farmer sold 12 bushels of wheat, at 75 cents a bushel, and 8 turkeys, at $1.25 each. He then bought 16 yards of cloth, at 87½ cents a yard, and spent the remainder for sugar, at 12½ cents a pound. How many pounds did he buy?

General Review.

LESSON XXXI.

1. Sold a horse for $72, and gained $\frac{2}{7}$ of the cost. Paid for him with coal, at $5 a ton. How many tons were required?

2. If a car-load of furniture can be moved 20 miles for $5, how far can it be carried for $12?

3. Having $150, I spent ⅙ of it for a stove, and ⅕ of the remainder for a carpet. How much money had I left?

4. How many steps, each 2 feet 8 inches long, would be taken in going 16 yards?

5. Bought ⅝ of a barrel of sugar, and sold ⅔ of what I bought. What part of the barrel was left?

6. C and D travel in opposite directions, C going $5\frac{4}{9}$ miles an hour, and D 4⅚ miles. How far apart will they be in 9 hours?

7. Paid $2¾ for a hat, and 1\frac{3}{10}$ for gloves. What *change should* I receive from a $5 bill?

8. Three boys can saw $\frac{3}{8}$ of a cord of wood apiece in a day. In how many days can they saw $6\frac{3}{4}$ cords?

9. If you have 63 cents, and $\frac{5}{7}$ of your money equals $\frac{3}{8}$ of mine, how much have I?

10. If a loaf of bread weigh 8 ounces when flour is $\$6\frac{1}{4}$ a barrel, what should it weigh when flour is $5 a barrel?

11. A horse cost $75. $\frac{8}{15}$ of the price of the horse was $\frac{10}{7}$ of the price of the harness. What was the cost of the harness?

12. Bought $2\frac{2}{3}$ dozen of handkerchiefs for $\$6\frac{2}{5}$, and sold them at $\$\frac{1}{4}$ apiece. Find my gain.

13. A man can dig a cistern in $4\frac{4}{5}$ days. What part of it can he dig in $2\frac{2}{3}$ days?

14. Bought eggs at 3 for 5 cents, and sold them at 5 for 11 cents. If I gained 16 cents, how many eggs did I sell?

15. B is pursuing A, who is 20 miles ahead. If B travels 10 miles an hour, and A $\frac{3}{4}$ as fast, in how many hours will B overtake him?

16. If $\frac{2}{3}$ of an apple cost $\frac{3}{5}$ of a cent, what will 100 apples cost?

17. If the wages of 4 men for 9 days is $72, what should 5 men earn in 7 days?

18. After spending $\frac{1}{3}$ and $\frac{3}{8}$ of my money, and losing $\frac{1}{12}$ of it, I had $\$2\frac{1}{2}$ remaining. How much had I at first?

19. Multiply 88 by $87\frac{1}{2}$; also, divide 1500 by $18\frac{3}{4}$.

20. If $6\frac{1}{4}$ is $1\frac{2}{3}$ times a certain number, what is $1\frac{3}{5}$ times the number?

21. A trader sold a horse for $99, and lost $\frac{2}{11}$ of the cost. Find his loss.

22. Having $72, I spent $\frac{1}{6}$ of it for a watch, and $\frac{1}{8}$ of the remainder for a chain. How much did I pay for both?

23. A can do a piece of work in 6 days, B in 10 days, C in 15 days. In what time can it be done if they work together?

24. Owning $\frac{9}{10}$ of a vessel, I sold $\frac{2}{3}$ of my share for $\$1500$. What was the value of the vessel, and what was my remaining interest worth?

25. If a man can build a fence in $4\frac{1}{6}$ days, what part of it can he build in $3\frac{1}{8}$ days?

26. Bought cloth at the rate of 3 yards for $\$4$, and sold it all at the rate of 2 yards for $\$3$. If the entire gain was $\$3$, how many yards were there?

27. A man hoes $1\frac{3}{4}$ acres of corn in a day, and a boy $\frac{2}{3}$ of an acre. How many acres will the man have hoed when the boy has finished 16 acres?

28. If it requires $1\frac{2}{3}$ yards of cambric for one lining, how many can be cut from 10 yards?

29. A sold B a watch for $\$90$, and gained $\frac{1}{5}$ of the cost. B then sold it, and lost $\frac{1}{5}$ of what it cost him. How much more did B lose than A gained?

30. If a loaf of bread weigh 9 ounces when flour is $\$6\frac{2}{3}$ a barrel, what should it weigh when flour is $\$7\frac{1}{2}$ a barrel?

31. How many hams, whose average weight is $10\frac{5}{8}$ pounds, will it take to weigh $42\frac{1}{2}$ pounds?

32. A farmer sold $\frac{3}{11}$ of $12\frac{5}{6}$ bushels of potatoes at one time, and $\frac{5}{9}$ of $8\frac{1}{10}$ bushels at another. How many bushels were sold?

33. A man had $\$84$. He spent $\frac{1}{6}$ of it for groceries, $\frac{3}{5}$ of the remainder for clothing, and $\frac{4}{7}$ of what then remained for a stove. How much had he left?

34. How long will it take a boat to move $14\frac{2}{3}$ miles, at the rate of $5\frac{1}{2}$ miles an hour?

35. A lady bought $2\frac{5}{8}$ yards of velvet for $\$15\frac{3}{4}$. Had she bought $1\frac{3}{4}$ yards more, what would her bill have been?

36. If a laborer works 5 days, at the rate of $\$8\frac{2}{5}$ for 6 days, what will he earn?

37. Hats cost $\$3\frac{3}{4}$ each, but were sold for $\frac{3}{5}$ of the cost. How many could have been bought for $36?

38. From $\frac{13}{10}$ of $1\frac{9}{26}$ times $\frac{20}{21}$ take $\frac{3}{4}$ of $\frac{4}{9}$ of $1\frac{1}{2}$.

39. B is following A, who is 40 miles ahead. B travels 10 miles per hour, and A $\frac{2}{3}$ of that distance. In how many hours will B overtake him?

40. By what must 6 be multiplied to make the product $\frac{1}{6}$?

41. C owns $39\frac{3}{4}$ acres of land, and D owns $3\frac{7}{10}$ acres less. How many acres do both own?

42. By selling a horse for $55, I lost $\frac{1}{12}$ of the cost. What part of the cost would I have gained by selling him for $75.

43. Bought 16 barrels of flour for $100, and sold $\frac{5}{8}$ of it for $55. How much per barrel was lost on the part sold?

44. A pair of pants cost $\$7\frac{1}{2}$, which was $\frac{3}{8}$ of the cost of a coat. The vest cost $\frac{2}{3}$ as much as the pants. What was the cost of the suit?

45. A hare is 80 yards ahead of a hound, and runs 12 feet in a second, while the hound runs 15 feet. In how many seconds will the hound catch the hare?

46. If a man can build a wall in $6\frac{3}{4}$ days by working 8 hours a day, in what time could he build a wall $3\frac{1}{3}$ times as long by working 6 hours a day?

47. B's coat cost $28, and his hat $6. $\frac{5}{7}$ of the cost of the coat $+$ $\frac{2}{3}$ that of the hat $=$ $\frac{4}{9}$ of the cost of his watch. What did the watch cost?

48. Sold a quantity of bacon for $39, thereby gaining $\frac{3}{10}$ of the cost. I paid for it with coffee at $\$\frac{1}{4}$ a pound. How many pounds were required?

49. If 10 horses eat 75 bushels of oats in 3 weeks, in *what time would* they eat 200 bushels?

50. In an orchard $\frac{1}{4}$ are apple trees, $\frac{3}{10}$ pear trees, $\frac{9}{25}$ cherry trees, and the remainder, which is 9, are quince trees. How many of each kind are there?

51. If $\frac{8}{9}$ of a yard of cloth cost \$2, how much can be bought for \$20?

52. A says to B, "Your age is 36 years, and $\frac{7}{9}$ of your age equals $\frac{4}{5}$ of mine. How old am I?"

53. A lady bought $6\frac{3}{4}$ yards of muslin at one time, and $5\frac{5}{6}$ yards at another. After using $7\frac{2}{8}$ yards, how much remained?

54. A farmer sold 24 bushels of potatoes at $62\frac{1}{2}$ cents a bushel, and 20 bushels of apples at $87\frac{1}{2}$ cents a bushel. He then bought 15 yards of cloth at $\$1.33\frac{1}{8}$ a yard, and spent the remainder for bacon at $12\frac{1}{2}$ cents a pound. How many pounds did he buy?

55. If a mechanic can earn $\$24\frac{3}{4}$ in 11 days of 9 hours each, how much can he earn in 10 days of 10 hours each?

56. After spending $\frac{5}{12}$ and $\frac{3}{8}$ of my money, and losing $\frac{1}{24}$ of it, I had only \$20 remaining. How much did I lose?

57. Sold a horse for \$40, losing $\frac{2}{7}$ of the cost. What part of the cost would I have gained by selling him for \$77?

58. If a family of 7 persons spend \$630 in 6 months, how much would they require for 4 months if 5 more persons were added?

59. Multiply 72 by $62\frac{1}{2}$. Also divide 1200 by $37\frac{1}{2}$.

60. Bought 48 yards of cloth at $87\frac{1}{2}$ cents a yard, and 12 barrels of flour at \$4.75 a barrel. Gave in exchange wheat at \$1.10 a bushel. How many bushels were required?

61. B is pursuing A, who is 24 miles ahead. B travels $7\frac{1}{2}$ miles an hour, and A $\frac{4}{5}$ of that distance. In how *many hours* will B overtake A?

62. I allowed an agent $\frac{3}{25}$ of all collections. If he received \$60, how much did I get?

63. 12 men can do a piece of work in $6\frac{1}{4}$ days. In how many days can 15 men do a piece 10 times as large?

64. A merchant bought $2\frac{2}{3}$ dozen neckties for \$$12\frac{4}{5}$. How much was that apiece?

65. By selling a lot of goods for \$36 I made $\frac{2}{7}$ of the cost. I paid for them with apples at \$$\frac{1}{2}$ a bushel. How many bushels did it take?

66. A sold B a gun for \$45, gaining $\frac{1}{8}$ of the cost. B sold it to C, and lost $\frac{1}{10}$ of what it cost him. How much more did A gain than B lost?

67. If a man can earn \$$13\frac{1}{2}$ in 9 days of 10 hours each, how much can he earn in 20 days of 12 hours each?

68. A buggy cost \$50, and a set of harness \$20. $\frac{9}{10}$ of the cost of the buggy + $\frac{3}{4}$ that of the harness = $\frac{3}{5}$ of the cost of a horse. What did the horse cost?

69. If a loaf of bread weigh 8 ounces when flour is \$$5\frac{1}{4}$ a barrel, what should it weigh when flour is \$4 a barrel?

70. Fred is 4 years older than Joe, and $\frac{2}{3}$ of Joe's age = $\frac{4}{7}$ of Fred's. How old is each?

71. If a family of 7 persons spend \$840 in 6 months, how much would support them 5 months if 3 more persons were added?

72. Cyrus can travel a certain distance in $5\frac{2}{5}$ hours. What part of it can he travel in $2\frac{1}{4}$ hours?

73. C is following D, who is $22\frac{1}{2}$ miles in advance. If C travels 9 miles an hour, and D goes $\frac{5}{6}$ as fast, in how many hours will C overtake him?

74. Alice lost $\frac{3}{10}$ of her pennies. She spent $\frac{5}{7}$ of the remainder for candy, and had 10 pennies left. How many had she at first?

75. If $6\frac{3}{4}$ yards of cloth cost \$$16\frac{1}{5}$, what will $7\frac{1}{2}$ yards cost?

76. In an orchard $\frac{2}{5}$ are apple trees, $\frac{1}{4}$ are pear trees, $\frac{3}{10}$ are plum trees, and the remainder, which is 5, are cherry trees. How many are there of each kind?

77. Sold 15 yards of cloth for \$35, and lost $\frac{1}{15}$ of the cost. Had I sold 8 yards for \$26, how much per yard would I have gained?

78. A, B, and C together earned \$100. A's share was $\frac{3}{8}$ of it, B's $\frac{7}{16}$, and C's the remainder. How much did each earn?

79. Bought 64 yards of cloth, at $62\frac{1}{2}$ cents a yard, and 18 barrels of apples, at $\$3.33\frac{1}{3}$ a barrel. Gave in exchange corn, at 50 cents a bushel. How many bushels were required?

80. Bought a cow for \$45, which was $\frac{1}{8}$ more than her value. I sold her for $\frac{1}{8}$ less than her value. How much did I lose?

81. If $\frac{5}{6}$ of a yard of velvet cost $\$3\frac{3}{4}$, how many yards could be bought for \$45?

82. By selling a horse for \$78, I made $\frac{3}{10}$ of the cost. I paid for him with corn, at $\$\frac{3}{5}$ a bushel. How many bushels did I give?

83. A cart cost \$24, and a set of harness \$7.50; $\frac{5}{12}$ of the cost of the cart $+$ $\frac{2}{3}$ that of the harness $=$ $\frac{3}{10}$ of the cost of a horse. What did the horse cost?

84. A rabbit is 80 yards ahead of a hound. The hound runs 20 feet in a second, and the rabbit 16 feet. In how many seconds will the hound catch him, and how far will each have run?

85. A sold B a gun for \$42, and gained $\frac{1}{6}$ of the cost. B then sold it, and lost $\frac{1}{6}$ of what it cost him. How much more did B lose than A gained?

86. Sold 72 bushels of corn at $37\frac{1}{2}$ cents a bushel, and 9 barrels of apples at $\$2.66\frac{2}{3}$ a barrel. I then bought 4 barrels of flour at $\$5.87\frac{1}{2}$, and 24 yards of cloth at $83\frac{1}{3}$

cents a yard, and spent the remainder for sugar at $12\frac{1}{2}$ cents a pound. How many pounds did I buy?

87. If 12 men can earn $108 in $4\frac{1}{2}$ days, how much can 11 men earn in $5\frac{1}{2}$ days?

88. Elmore undertook a journey. After he had gone 36 miles, there remained $\frac{5}{9}$ of the distance. When he had traveled $\frac{3}{5}$ of the remainder, how much farther had he to go?

89. Sarah bought $6\frac{2}{3}$ yards of gingham at one time, and $7\frac{3}{4}$ yards at another. She used $9\frac{5}{12}$ yards, and gave $\frac{2}{5}$ of the remainder to her sister. How much had she left?

90. B is pursuing C, who is 45 miles in advance. If B travels 12 miles an hour, and C $\frac{5}{8}$ of that distance, in how many hours will B overtake him?

91. John lost $\frac{4}{9}$ of his marbles. He gave $\frac{3}{5}$ of the remainder to his brother, and had 18 marbles left. How many did his brother receive?

92. If a loaf of bread weigh 10 ounces when flour is $\$7\frac{1}{2}$ a barrel, what should it weigh when flour is $\$6\frac{1}{4}$ a barrel?

93. A man can do a certain work in $6\frac{1}{4}$ days. What part of the work can he do in $3\frac{1}{3}$ days?

94. A says to B, "Your age is 24 years, and $\frac{7}{8}$ of your age is 6 years less than $\frac{9}{10}$ of mine. How old am I?"

95. If a freight train travel at the rate of 38 miles in $4\frac{3}{4}$ hours, how far will it travel in $12\frac{1}{2}$ hours?

96. Add $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{9}{10}$ of 20.

97. What is the difference between the sum of 5 and 2 multiplied by their difference, and $5 + 2 \times 5 - 2$?

98. Gloves cost $\$1\frac{3}{4}$ a pair, but were reduced to $\frac{4}{5}$ of the cost. How many pairs could then be bought for $\$11\frac{1}{5}$?

99. $\$1\frac{1}{2}$ will buy $3\frac{3}{4}$ yards of ribbon. How much will $\frac{3}{8}$ *of* $\$6\frac{2}{3}$ *buy?*

100. What fraction is that from which if you subtract $\frac{2}{5}$ of itself, and then add to the remainder its one-half, the result will be $\frac{4}{5}$?

101. A farmer sold $\frac{4}{9}$ of his chickens at one time, $\frac{1}{6}$ at another, and then had $3\frac{1}{2}$ dozen remaining. How many had he at first?

102. Three boys divided a sum of money. One took $\frac{5}{12}$, another $\frac{1}{4}$, and the third received $15. How much did the others each receive?

103. Jesse has a certain distance to travel. After going 15 miles, there still remain $\frac{3}{5}$ of the distance. When he has traveled $\frac{3}{5}$ of the remainder, how far must he then go?

104. Owning $\frac{4}{5}$ of a vessel, I sold $\frac{3}{8}$ of my share for $1200. What was the value of the vessel, and what was my remaining interest worth?

105. A vest cost $$4\frac{1}{2}$, which was $\frac{2}{9}$ of the cost of a coat. If the pants cost $1\frac{2}{3}$ times as much as the vest, what was the cost of the suit?

106. A rides 15 miles in $1\frac{2}{3}$ hours, B 36 miles in $4\frac{1}{2}$ hours. How far will A go while B is riding 60 miles?

107. In an orchard of apple and pear trees, the latter are $\frac{4}{11}$ of the entire number. The apple trees are 21 more than the pear. How many of each are there?

108. A is 21 years older than B. B's age is $\frac{5}{12}$ of A's. How old is each?

109. A sold B a cow for $54, and gained $\frac{1}{8}$ of the cost. B then sold her, and lost $\frac{1}{6}$ of what she cost him. How much more did B lose than A gained?

110. A father is 38 years older than his son. The son's age is $\frac{5}{24}$ of the father's. What is the age of each?

111. If 25 gallons per hour run into a vessel of 100 gallons capacity, and $37\frac{1}{2}$ gallons run out in two hours, in what time will the vessel be filled?

112. A travels 54 miles in $6\frac{3}{4}$ hours; B, 36 miles in $3\frac{3}{5}$ hours. How far will B go while A is traveling 28 miles?

113. Bought a buggy for $46, which was $\frac{3}{20}$ more than its value. I sold it for $\frac{1}{10}$ less than its value. What was the loss?

114. A farmer sowed $\frac{4}{15}$ of his land in wheat, and planted the remainder in corn. If there were 14 more acres in corn than in wheat, how many acres of each were there?

115. My age + its $\frac{2}{3}$ and its $\frac{5}{6}$ equals $\frac{5}{6}$ of my father's age, which is 72 years. How old am I?

116. Harry gave $\frac{2}{9}$ of his marbles to Robert, $\frac{3}{7}$ of the remainder to Albert, and had 20 marbles remaining. How many did Albert receive?

117. James spent $\frac{2}{5}$ of his money, and then earned $\frac{5}{6}$ as much as he spent. He then had $20 less than at first. How much had he at first?

118. Multiply $\frac{5}{12} + \frac{3}{8} \times \frac{5}{9}$ by $\frac{14}{15} - \frac{8}{10} \times \frac{4}{9}$.

119. A can mow 5 acres in 4 days, and B can mow 4 acres in 5 days. How many acres can both mow in 10 days?

120. Divide $375 among A, B, and C, so that B's share shall be $\frac{2}{3}$ of A's, and C's shall be $\frac{1}{2}$ as much as both of the others.

121. If a yardstick held upright casts a shadow $4\frac{1}{2}$ feet long, how high is a tree whose shadow at the same time is $67\frac{1}{2}$ feet long?

122. Stephen is $\frac{5}{6}$ as old as Samuel, and Frank is $\frac{3}{4}$ as old as Stephen. If Samuel is 9 years older than Frank, how old is Stephen?

123. A farmer sold $\frac{3}{10}$ of his land. He then bought 80 acres, and found that he had $\frac{3}{2}$ as much as at first. How many acres had he at first?

Section III.

TABLES.

LESSON I.

United States Money.

10 mills (*m.*) - - - make 1 cent, marked *ct.*
10 cents - - - - - " 1 dime, " *d.*
10 dimes - - - - " 1 dollar, " *$.*
10 dollars - - - - " 1 eagle, " *E.*

1. How many mills in 5 cents? in 7? in 9? in 10? in 15?
2. How many cents in 4 dimes? in 6? in 8? in 10? in 20?
3. How many dimes in 3 dollars? in 5? in 9? in 11? in 13?
4. How many dollars in 5 eagles? in 7? in 10? in 16? in 25?
5. How many mills in 1 dime? in 4? in 6? in 8? in 10?
6. How many cents in 1 dollar? in 5? in 7? in 9? in 12?
7. How many dollars in 400 cents? in 600? in 1000? in 2500?
8. How many dimes in 50 cents? in 90? in 150? *in 500?*

9. How many dollars in 40 dimes? in 180? in 750? in 1250?

10. How many cents in \$$\frac{1}{2}$? $\frac{1}{4}$? $\frac{2}{5}$? $\frac{3}{10}$? $\frac{7}{20}$? $\frac{8}{25}$? $\frac{11}{50}$? $\frac{99}{100}$?

11. What part of \$1 is 2 cents? 4 cents? 5 cents? $6\frac{1}{4}$ cents? $6\frac{2}{3}$ cents? $8\frac{1}{3}$ cents? 10 cents? $12\frac{1}{2}$ cents? $16\frac{2}{3}$ cents? 20 cents? 25 cents? $33\frac{1}{3}$ cents? $37\frac{1}{2}$ cents? 40 cents? 50 cents? $62\frac{1}{2}$ cents? $66\frac{2}{3}$ cents? 75 cents? $83\frac{1}{3}$ cents? $87\frac{1}{2}$ cents? 95 cents?

LESSON II.

Dry Measure.

2 pints (*pt.*) - - - make 1 quart, marked *qt.*
8 quarts - - - - - " 1 peck, " *pk.*
4 pecks - - - - " 1 bushel, " *bu.*

1. How many pints in 3 quarts? in 5? in 7? in 9?

2. How many quarts in 4 pecks? in 6? in 8? in 10?

3. How many pecks in 5 bushels? in 7? in 9? in 12?

4. How many quarts in 8 pints? in 12? in 20? in 50?

5. How many pecks in 24 quarts? in 40? in 72? in 96?

6. How many bushels in 16 pecks? in 28? in 48? in 60?

7. Reduce 7 qt. 1 pt. to pints; 2 pk. 5 qt. to quarts.

8. Reduce 5 bu. 2 pk. to pecks; 2 bu. 1 pk. to quarts.

9. Reduce 3 pk. 4 qt. to pints; 2 pk. 5 qt. 1 pt. to pints.

10. Reduce 3 bu. 3 pk. 3 qt. to quarts; 1 bu. 1 pt. to pints.

11. Reduce 1 bu. 2 pk. 3 qt. to pints; 3 pk. 7 qt. to pints.

12. Reduce 1 bu. 1 pk. 1 qt. 1 pt. to pints; 1 bu. 2 pk. 2 qt. to pints.

13. Reduce 37 pt. to pecks; 49 pt.; 56; 60; 63.

14. Reduce 75 qt. to bushels; 87 qt.; 96; 99; 121.

15. Reduce 144 pt. to bushels; 180 pt.; 215; 256; 300.

16. Reduce 324 pt. to bushels; 333 pt.; 361; 375; 400.

17. How many quarts in 10 bu. 3 pk. 6 qt.?

18. How many pints in 3 pk. 7 qt. 1 pt.?

19. How many pints in 3 bu. 4 qt.?

20. How many pints in 31 bu. 1 pk. 1 pt.?

21. 1 pt. is what part of a quart? of a peck? of a bushel?

22. 3 qt. are what part of a peck? of a bushel?

LESSON III.

Avoirdupois Weight.

16 drams (*dr*) - - make 1 ounce, marked *oz.*
16 ounces - - - " 1 pound, " *lb.*
100 pounds make 1 hundredweight, " *cwt.*
20 hundredweight - - make 1 ton, " *T.*

1. How many drams in 3 oz.? in 4? in 6? in 10?

2. How many ounces in 3 lb.? in 5? in 7? in 9?

3. How many pounds in 5 cwt.? in 8? in 10? in 15?

4. How many hundredweight in 4 T.? in 7? in 9? in 11?

5. How many ounces in 32 dr.? in 96? in 80? in 128?

6. How many pounds in 48 oz.? in 64? in 112? in 144?

7. How many hundredweight in 1000 lb.? in 2500? in 10000?

8. How many tons in 60 cwt.? in 100? in 180? in 240?

9. Reduce 6 oz. 3 dr. to drams; 9 lb. 6 oz. to ounces.

10. Reduce 8 cwt. 64 lb. to pounds; 2 T. 2 cwt. 2 lb. to pounds.

11. Reduce 1 lb. 4 oz. 5 dr. to drams; 3 cwt. 12 lb. 8 oz. to ounces.

12. Reduce 5 T. 11 cwt. 11 lb. to pounds; 1 T. to ounces.

13. Reduce 100 dr. to ounces; 170 oz. to pounds.

14. Reduce 1025 lb. to hundredweight; 1601 oz. to hundredweight.

15. Reduce 33 cwt. to tons; 2275 lb. to tons.

16. Reduce 16000 oz. to hundredweight; 96000 oz. to tons.

17. How many drams in 2 lb. 8 oz.?

18. How many ounces in 6 cwt. 6 lb. 4 oz.?

19. How many pounds in 4 T. 19 cwt. 99 lb.?

20. 10 oz. are what part of a pound? of a hundredweight?

21. 40 lb. are what part of a hundredweight? of a ton?

LESSON IV.

Liquid Measure.

4 gills (*gi.*) - make 1 pint, marked *pt.*
2 pints - - - " 1 quart, " *qt.*
4 quarts - - - " 1 gallon, " *gal.*
31½ gallons - - " 1 barrel, " *bl.*
63 gallons (or 2 bl.) " 1 hogshead, " *hhd.*

1. How many gills in 3 pt.? in 5? in 7? in 9?

2. How many pints in 4 qt.? in 6? in 8? in 10?

3. How many quarts in 5 gal.? in 7? in 9? in 11?

4. How many gallons in 2 bl.? in 3? in 5? in 8?

5. How many barrels in 5 hhd.; in 11? in 16? in 25?

6. How many pints in 16 gi.? in 24? in 40? in 64?

7. How many quarts in 18 pt.? in 26? in 42? in 50?

8. How many gallons in 24 qt.? in 32? in 52? in 60?

9. How many barrels in 94½ gal.? in 157½? in 252?

10. How many hogsheads in 189 gal.? in 315? in 504?

11. Reduce 1 qt. 1 pt. 1 gi. to gills; 4 gal. 3 qt. 1 pt. to pints.

12. Reduce 1 gal. 1 pt. to gills; 1 barrel to pints.

13. Reduce 2 hhd. 24 gal. to quarts; 1 hhd. to pints.

14. Reduce 64 gi. to gallons; 45 gi. to gallons.

15. Reduce 121 pt. to gallons; 630 qt. to barrels.

16. Reduce 756 qt. to hogsheads; 2016 pt. to hogsheads.

17. How many gills in 5 gal. 1 qt. 1 pt. 3 gi.?
18. How many pints in 1 hhd. 62 gal.?
19. How many quarts in 10 bl. 10 gal.?
20. 1 pt. 3 gi. are what part of a quart? of a gallon?
21. 3 qt. 1 pt. are what part of a gallon? of a barrel?

Lesson V.

Troy Weight.

24 grains (*gr.*) - make 1 pennyweight, marked *pwt.*
20 pennyweights " 1 ounce, " *oz.*
12 ounces - - " 1 pound, " *lb.*

1. How many grains in 3 pwt.? in 5? in 7? in 10?

2. How many pennyweights in 4 oz.? in 6? in 12? in 15?

3. How many ounces in 5 lb.? in 9? in 12? in 20?

4. How many pennyweights in 48 gr.? in 96? in 144? in 216?

5. How many ounces in 60 pwt.? in 100? in 180? in 500?

6. How many pounds in 84 oz.? in 120? in 192? in 600?

7. Reduce 1 oz. 20 gr. to grains; 1 lb. 8 oz. to pennyweights.

8. Reduce 5 oz. 1 pwt. to grains; 10 lb. 5 oz. to pennyweights.

9. Reduce 2 oz. 10 pwt. 12 gr. to grains.

10. Reduce 6 lb. 3 oz. 10 pwt. to pennyweights.

11. Reduce 245 gr. to pennyweights; 230 pwt. to ounces.

12. Reduce 960 gr. to ounces; 720 pwt. to pounds.

13. Reduce 701 pwt. to pounds; 725 gr. to ounces.

14. How many grains in 1 oz. 10 pwt. 10 gr.?
15. How many pennyweights in 4 lb. 2 oz. 1 pwt.?
16. How many grains in 3 oz. 10 gr.?
17. 15 gr. are what part of a pwt.? of an oz.?
18. 12 pwt. are what part of an oz.? of a lb.?
19. 3 pwt. 8 gr. are what part of an ounce?
20. 3 oz. 12 pwt. are what part of a pound?

LESSON VI.

Long Measure.

12 inches (*in.*) - - make 1 foot, marked *ft.*
3 feet - - - - - - - " 1 yard, " *yd.*
$5\frac{1}{2}$ yards (or $16\frac{1}{2}$ feet) - " 1 rod, " *rd.*
320 rods - - - - - - - " 1 mile, " *mi.*

1. How many inches in 5 ft.? in 7? in 9? in 12?
2. How many feet in 6 yd.? in 10? in 15? in 25?
3. How many yards in 8 rd.? in 9? in 12? in 20?
4. How many rods in 3 mi.? in 5? in 8? in 10?
5. How many feet in 48 in.? in 72? in 96? in 132?
6. How many yards in 21 ft.? in 36? in 63? in 99?
7. How many rods in 44 yd.? in 77? in 99? in 121?
8. How many miles in 640 rd.? in 1280? in 1920?
9. Reduce 1 yd. 1 ft. 1 in. to inches; 2 yd. 2 ft. 4 in. to inches.
10. Reduce 2 rd. 2 yd. 2 ft. to feet; 10 rd. 5 yd. 1 ft. to feet.
11. Reduce 2 mi. 160 rd. to rods; 1 mi. 80 rd. to yards.

12. Reduce 45 in. to feet; 150 in. to yards.

13. Reduce 132 ft. to rods? 297 ft. to rods.

14. Reduce 110 yards to rods; 100 yd. to rods.

15. Reduce 960 rods to miles; 1600 rods to miles.

16. 8 in. are what part of a foot? 6 in.? 10 in.?

17. 9 in. are what part of a foot? of a yard? of a rod?

18. 2 ft. are what part of a yard? of a rod?

19. 4 yd. are what part of a rod?

20. 64 rd. are what part of a mile? 240 rods?

LESSON VII.

Square Measure.

144 square inches (*sq. in.*)	make	1 square foot,	marked	*sq. ft.*
9 square feet - - -	"	1 square yard,	"	*sq. yd.*
$30\frac{1}{4}$ square yards - - -	"	1 square rod,	"	*sq. rd.*
160 square rods - - -	"	1 acre,	"	*A.*
640 acres - - - - - -	"	1 square mile,	"	*sq. mi.*

1. How many square inches in 2 sq. ft.? in 5? in 10?

2. How many square feet in 4 sq. yd.? in 7? in 12? in 20?

3. How many square yards in 4 sq. rd.? in 8? in 12? in 20?

4. How many square rods in 3 A.? in 5? in 8? in 10?

5. How many acres in 2 sq. mi.? in 3? in 5? in 10?

6. How many square feet in 432 sq. in.? in 864? in 576?

7. How many square yards in 81 sq. ft.? in 144? in 225?

8. How many acres in 640 sq. rd.? in 1600? in 1440?

9. How many square miles in 2560 A.? in 3840? in 3200?

10. Reduce 4 sq. ft. to sq. in.; 198 sq. ft. to sq. yd.

11. Reduce 16 sq. rd. to sq. yd.; 960 sq. rd. to A.

A *square* is a figure having four equal sides, and four right angles.

A *rectangle* is a figure having four sides and four right angles.

The area of a square is found by multiplying one side by itself.

The area of a rectangle is found by multiplying the length by the breadth.

If the area of a rectangle be divided by either side, the quotient will be the other side.

12. One side of a square room is 5 yd. in length. What is its area?

Solution: Its area is 5 yd. × 5 yd. = 25 sq. yd. *Answer:* 25 sq. yd.

13. A lot in the form of a rectangle is 3 rd. wide, and its area is 27 sq. rd. How long is the lot?

Solution: Its length is 27 sq. rd. ÷ 3 rd. = 9 rd. *Answer:* 9 rd.

14. A platform is 36 ft. long, and 30 ft. wide. How many sq. yd. are in it?

15. A ceiling is 24 ft. long, and 15 ft. wide. What would it cost to paint it at 25 cents a sq. yd.?

16. A garden is 16 rd. wide, and 30 rd. long. How many A. does it contain?

17. How many planks 1½ ft. wide, and 10 ft. long would be required for a walk 3 ft. wide, and 150 ft. long?

18. A pasture is 25 rd. wide, and 32 rd. long. Find its value at $50 per A.

19. What is the difference in area between two grass plots, one 15 ft. square, and the other 12 by 18 ft?

20. The roof of a barn is 20 by 50 ft. on each side. Find the cost of shingling it, at $2.50 per 100 sq. ft.

21. Find the cost of polishing a granite slab 2½ ft. long, and 2 ft. wide, at 1 cent a sq. inch.

22. What would it cost to cement a cellar 30 by 18 ft., at $.33⅓ a sq. yd?

23. How much more would it cost to carpet a room 21 ft. long, and 15 ft. wide, than a room 15 ft. wide, and 18 ft. long, at $1.50 a sq. yd?

24. A lot is 45 yd. long, and its area is 900 sq. yd. Find the cost of the fence surrounding it, at 20 ct. a yd.

25. A field 50 rd. long cost $1000, at $100 per A. How wide was the field?

26. What would it cost to paper the walls and ceiling of a parlor 18 ft. long, 15 ft. wide, and 9 ft. high, at 16⅔ ct. a square yard?

LESSON VIII.

Time Measure.

60 seconds (*sec.*) -	make	1 minute,	marked	*min.*
60 minutes - - -	"	1 hour,	"	*hr.*
24 hours - - - -	"	1 day,	"	*da.*
365 days - - - -	"	1 year,	"	*yr.*
366 days - - - -	"	1 leap year,	"	*yr.*
7 days - - - - -	"	1 week,	"	*wk.*
52 weeks - - - -	"	1 year,	"	*yr.*
12 calendar months -	"	1 year,	"	*yr.*
100 years - - - -	"	1 century,	"	*cen.*

NOTE.—*In business transactions, and in interest, it is customary to regard* 30 *days as a month.*

The number of days belonging to each of the months can easily be recollected by memorizing the following lines:

> "Thirty days have September,
> April, June, and November.
> All the rest have thirty-one
> Except the second month alone;
> To this we twenty-eight assign,
> Till leap year gives us twenty-nine."

1. How many seconds in 3 min.? in 6? in 9? in 11?

2. How many minutes in 5 hr.? in 7? in 10? in 12?

3. How many hours in 3 da.? in 5? in 7? in 20?

4. How many days in 6 wk.? in 9? in 12? in 25?

5. How many minutes in 240 sec.? in 420? in 600? in 720?

6. How many hours in 180 min.? in 300? in 480? in 660?

7. How many days in 48 hr.? in 96? in 144? in 192?

8. How many weeks in 35 da.? in 56? in 91? in 147?

9. Reduce 8 min. 20 sec. to seconds; 5 hr. 33 min. to minutes.

10. Reduce 6 da. 16 hr. to hours; 14 wk. 3 da. to days.

11. Reduce 1 wk. 3 da. 10 hr. to hours; 5 wk. 5 da. 15 hr. to hours.

12. 7 min. 30 sec. are what part of an hour?

13. 4 hr. 30 min. are what part of a day?

14. What part of a year are 4 mo. 24 da.?

Solution: 24 da. $= \frac{4}{5}$ mo.; $4\frac{4}{5}$ mo. $\div 12 = \frac{2}{5}$ yr. ***Answer:*** $\frac{2}{5}$ yr.

15. What part of a year are 9 mo. 18 da.? 7 mo. 6 da.?

16. What part of a year are 1 mo. 15 da.? 4 mo. 15 da.?

17. What part of a year are 7 mo. 15 da.? 10 mo. 15 da.?

18. What part of a year are 2 mo. 20 da.? 5 mo. 10 da.?

19. What part of a year are 9 mo. 10 da.? 10 mo. 20 da.?

20. What part of a year are 1 mo. 6 da.? 3 mo. 18 da.?

21. What part of a year are 4 mo. 24 da.? 6 mo. 20 da.?

22. What part of a month are 3 da.? 5 da.? 6 da.? 9 da.?

23. What part of a month are 10 da.? 12 da.? 15 da.? 18 da.?

24. What part of a month are 20 da.? 21 da.? 24 da.? 25 da.?

LESSON IX.

Miscellaneous Tables.

12 units - - - - - - - make 1 dozen.
12 dozen - - - - - - - " 1 gross.
12 gross - - - - - - - " 1 great gross.
20 units - - - - - - - " 1 score.
24 sheets - - - - - - " 1 quire.
20 quires - - - - - - - " 1 ream.
2 reams - - - - - - - " 1 bundle.
100 pounds of nails - - " 1 keg.
196 pounds of flour - - " 1 barrel.
200 pounds of beef or pork " 1 barrel.

Find the cost of

1. 10 eggs at 18 ct. a dozen. 5 quires of note paper at 5 m. a sheet.

2. 8 lead-pencils at $3.60 a gross. 3 kegs of nails at $3\frac{1}{3}$ ct. a pound.

3. 49 lb. of flour at $4.80 a barrel. 6 score of crayons at $2\frac{1}{2}$ ct. a dozen.

4. 75 lb. of beef at $16 a barrel. 9 dozen pens at $14.40 a great gross.

5. 8 quires of foolscap at $3.60 a ream. 70 lb. of flour at $5.60 a barrel.

6. 45 eggs at 16 ct. a dozen. $\frac{5}{7}$ of a barrel of flour at 3 ct. a pound.

7. $2\frac{1}{2}$ gross of marbles at 4 ct. a dozen. 25 lb. of nails at $3.20 a keg.

8. 25 dozen crayons at $3\frac{1}{3}$ ct. a score. $\frac{5}{8}$ barrel of pork at 6 ct. a pound.

9. 20 paper collars at $1.80 a gross. 5 reams of paper at 15 ct. a quire.

10. If a barrel of flour were emptied into 28-pound sacks, and sold at 75 cents a sack, what would be received for it?

11. 5 gross of buttons were sold for 5 cents a dozen, by which $1.20 was gained. What was the cost per gross?

12. Bought a quantity of pork, and sold it all for $100, at $8\frac{1}{3}$ cents a pound. How many barrels were there?

13. Bought 960 marbles at 5 ct. a score, and sold them at 5 ct. a dozen. Find my gain.

14. Three tons of iron was made into nails, and sold at $3.50 a keg. What was the selling price?

15. Three lb. of steel was manufactured into pens. Allowing $1\frac{1}{2}$ oz. to the gross, what was the entire number *worth at 5* cents a dozen?

LESSON X.

Find the value in integers of $\frac{5}{16}$ bushel.

Solution: $\frac{5}{16}$ bu. $= \frac{5}{16}$ of 4 pk. $= 1\frac{1}{4}$ pk; $\frac{1}{4}$ pk. $= \frac{1}{4}$ of 8 qt. $= 2$ qt. *Answer:* 1 pk. 2 qt.

Find the value in integers of

1. $\frac{9}{16}$ bu.; $\frac{11}{16}$ pk.; $\frac{31}{32}$ bu.; $\frac{15}{16}$ pk.; $\frac{19}{64}$ bu.
2. $\frac{9}{40}$ T.; $\frac{3}{16}$ cwt.; $\frac{25}{32}$ lb.; $\frac{11}{80}$ T.; $\frac{3}{32}$ cwt.
3. $\frac{5}{14}$ hhd.; $\frac{3}{7}$ bl.; $\frac{11}{16}$ gal.; $\frac{7}{8}$ qt.; $\frac{9}{14}$ bl.
4. $\frac{13}{16}$ lb. Troy; $\frac{3}{8}$ oz.; $\frac{17}{32}$ lb.; $\frac{9}{16}$ oz.; $\frac{27}{64}$ lb.
5. $\frac{15}{64}$ mi.; $\frac{19}{22}$ rd.; $\frac{7}{8}$ yd.; $\frac{15}{44}$ rd.; $\frac{9}{128}$ mi.
6. $\frac{5}{24}$ wk.; $\frac{11}{40}$ da.; $\frac{6}{25}$ hr.; $\frac{5}{16}$ wk.; $\frac{15}{64}$ da.
7. 1 pk. 4 qt. 1 pt. are what part of a bushel?

Solution: 4 qt. 1 pt. $= 4\frac{1}{2}$ qt. $= \frac{9}{16}$ pk.; $1\frac{9}{16}$ pk. $= \frac{25}{16} \div 4 = \frac{25}{64}$ bu. *Answer:* $\frac{25}{64}$.

8. 2 cwt. 25 lb. are what part of a ton?
9. 40 gal. 2 qt. are what part of a hogshead?
10. 11 oz. 5 pwt. are what part of a pound?
11. 3 yd. 2 ft. 3 in. are what part of a rod?
12. 3 da. 2 hr. 40 min. are what part of a week?
13. Reduce 1 pk. 3 qt. to the fraction of a bushel.
14. Reduce 6 cwt. 25 lb. to the fraction of a ton.
15. Reduce 22 gal. 2 qt. to the fraction of a hogshead.
16. Reduce 12 pwt. 12 gr. to the fraction of an ounce.
17. Reduce 1 yd. 1 ft. 6 in. to the fraction of a rod.
18. Reduce 1 da. 9 hr. 36 min. to the fraction of a week.
19. Reduce 6 mo. 12 da. to the fraction of a year.
20. If the interest of a sum of money is $90 for one year, what should it be for 5 mo. 10 da.?
21. A certain sum of money produced $50 interest in one year. How much interest should it produce in 2 yr. 4 mo. 24 da.?

Review.

LESSON XI.

1. Find the value of 1 pk. 4 qt. 1 pt. of berries, at $1.28 a bushel.

2. How much cider, at 32 cents a quart, can be bought for $.60?

3. If $\frac{3}{5}$ of a ton of hay cost $9, what will 12 cwt. 80 lb. cost?

4. If an ounce of refined gold is worth $24, how much could be bought for $7.50?

5. What would be the cost of 5 yd. 2 ft. 6 in. of lace, at $1.20 a yard?

6. A steamer sailed from Louisville to Cincinnati in 16 hr. 52 min. 30 sec., at the rate of 8 miles an hour. What is the distance?

7. How many days in the first four months of 1896?

8. Paid $6.75 for sirup, at the rate of $18.90 a barrel. How much did I buy?

9. A farmer gave $4.45 for clover-seed, at $3.20 a bushel. How much did he buy?

10. What would be the value of 5 lb. 7 oz. 10 pwt. of silver, at $16 a pound?

11. A man paid $24 for fencing his lot, at 1.33\frac{1}{3}$ a rod. If the lot was 99 feet long, how many feet wide was it?

12. A stage-coach was driven 50 mi. at the rate of 9 miles an hour. In what time was the trip made?

13. There are 5280 feet in a mile. If the fore wheel of a carriage is 10 ft. in circumference, and the hind wheel 12 ft., how many more revolutions will the former make than the latter in traveling a mile?

14. A cask of wine was bought for $1.50 per gal., and sold for 22 ct. 5 m. per pt., by which a profit of $18 was made. How many gallons were in the cask?

15. 50 bu. of peaches were packed in baskets, each holding 2 pk. 4 qt., and sold at $1.25 a basket. How much was realized?

16. How many dozen pint bottles would be required to hold a hhd. of wine?

17. An express train ran a certain distance in 10 min. 40 sec., at the rate of 150 rd. per min. What was the distance?

18. How much iron would be required to shoe 100 cavalry horses, allowing 10 oz. to each shoe?

19. How many da. from Sept. 11 to Dec. 25? How many weeks?

20. A jeweler paid $162 for gold, at $18 an oz., and made it into rings weighing 4 pwt. 12 gr. each, which he sold at $4.50 apiece. Find his gain.

21. A lady bought 5 yd. 1 ft. 8 in. of silk, at $1.80 a yd. What did she pay for it?

22. There are 25 bu. in a ton of coal. How much would 200 bu. cost, at $4.50 a ton? How much a bushel?

23. A milkman received $1.35 for a can of milk, at 3 cents a pt. How much did the can contain?

24. In the above question, had the milk been sold for 32 cents a gal., what would he have received for it?

25. If an express train runs 2 rods in a second, in what time can it run 5 mi. 200 rd.?

26. 5 bushels of strawberries cost $16. How much was that a pint?

27. A vessel was filled in 10 min. 40 sec. by a pipe that discharged 1 pt. 1 gi. per sec. How many gal. did it hold?

28. A carpenter agreed to work 10 hr. a day, at the

rate of 5 mills per min. If his wages amounted to $37½, how many da. did he work?

29. If a buggy-wheel is 3 yd. 2 ft. in circumference, how far will it go in making 10 revolutions?

30. A man rode 45 mi. on his bicycle in 5 hr. 37 min. 30 sec. At what rate per hour did he travel?

31. There are 25 bu. in a ton of coal. How many bu. can be bought for $16.25, at the rate of $3.25 a ton?

32. A merchant bought 25 gal. of cider at 20 ct. a gal., and sold it for 3 ct. 5 mi. a pt. Find his gain.

33. A poulterer has 40 turkeys. If he feed each of them a pint of corn daily for 40 da., what would be the value of the corn, at 40 ct. a bu.?

34. If 1 bu. 2 pk. 2 qt. of beans cost $2.50, how much is that a bu.?

35. What would be the cost of 5 gal. 3 qt. 1 pt. 2 gi. of wine, at $1.60 a gal.?

36. A town lot is 148½ ft. long, and 49½ ft. wide. Find the cost of the fence surrounding it, at $1.25 a rod.

Section IV.

QUESTIONS.

LESSON I.

1. What number is that, which added to its $\frac{4}{5}$ will equal 27?

Solution: The number is $\frac{5}{5}$. Then $\frac{5}{5} + \frac{4}{5} = \frac{9}{5}$ of the number, which $= 27$. $\frac{1}{5} = 3$, and $\frac{5}{5} = 15$. *Answer:* 15.

2. Divide 39 into two parts, so that the less shall be $\frac{4}{9}$ of the greater.

3. A and B together own 80 acres of land. If B owns $1\frac{2}{3}$ times as much as A, how many acres has each?

4. Divide 63 into three parts, so that the second shall be $\frac{1}{2}$, and the third $\frac{3}{5}$ of the first part.

5. Divide 60 into three parts, so that the second shall be $\frac{4}{5}$ of the first, and the third $\frac{3}{4}$ of the second.

6. A, B, and C together had $45. B had $\frac{2}{3}$, and C $\frac{5}{6}$ as much as A. How much had each?

7. D, E, and F picked 100 quarts of blackberries. E picked $\frac{4}{5}$, and F $\frac{7}{10}$ as many quarts as D. How many quarts did each pick?

8. A has $\frac{5}{8}$ as much money as B, and B has $\frac{3}{5}$ as much as C. Together they have $160. How much has each?

9. A tree 95 feet high was broken into three pieces. The middle part was $\frac{3}{5}$ as long as the top, and the lower

part was $\frac{1}{2}$ as long as the middle. What was the length of each part?

10. On a farm there are 112 animals—sheep, cows, and horses. There are $\frac{5}{9}$ as many cows as sheep, and $\frac{2}{5}$ as many horses as cows. How many of each kind are there?

11. The age of A is 2 times the age of B. B's age is 4 times C's. If A is 42 years older than C, how old is each?

12. A poulterer raised 210 fowls—geese, ducks, and chickens. He raised $\frac{4}{5}$ as many ducks as chickens, and $\frac{2}{3}$ as many geese as ducks. How many of each kind are there?

13. A chain cost $\frac{8}{10}$ as much as a watch. Four times the price of the chain + twice the price of the watch = \$128. What did each cost?

14. A colt cost $\frac{3}{8}$ as much as a horse. Twice the price of the colt + 3 times the price of the horse = \$210. What was the cost of each?

15. A son is 35 years younger than his father. If the father's age is $\frac{7}{2}$ of the son's, what is the age of each?

16. B's money is $\frac{5}{8}$ of A's, and $\frac{2}{5}$ of B's is \$36 less than A's. How much has each?

17. A farmer has 81 bu. of wheat and corn, and $\frac{3}{8}$ of the number of bu. of wheat $= \frac{6}{11}$ of the number of bu. of corn. How many bu. of each has he?

18. In an orchard of 92 apple and pear trees, $\frac{4}{5}$ of the apple trees $= \frac{8}{13}$ of the pear trees. How many are there of each?

Solution: If $\frac{4}{5}$ of the apple trees $= \frac{8}{13}$ of the pear, $\frac{1}{5}$ of the apple trees $= \frac{2}{13}$ of the pear, and $\frac{5}{5}$ of the apple trees $= \frac{10}{13}$ of the pear. The pear trees $= \frac{13}{13}$. Then $\frac{13}{13} + \frac{10}{13} = \frac{23}{13}$ of the pear trees, which $= 92$. $\frac{1}{13} = 4$. $\frac{13}{13} = 52$. $\frac{10}{13} = 40$. *Answer:* 52 pear trees; *40 apple trees.*

19. In a field containing 69 horses and cows, $\frac{4}{7}$ of the cows = $\frac{8}{9}$ of the horses. How many of each are there?

20. A poulterer raised 76 ducks and geese, and $\frac{2}{5}$ of the ducks = $\frac{4}{9}$ of the geese. How many of each did he raise?

21. In a school of 68 pupils, $\frac{3}{5}$ of the boys = $\frac{6}{7}$ of the girls. How many of each attend the school?

22. In an orchard of plum and cherry trees, 98 in all, $\frac{3}{8}$ of the plum trees = $\frac{9}{25}$ of the cherry trees. How many of each are there?

23. The age of A is 4 times the age of B. The age of B is 3 times the age of C. A is 55 years older than C. How old is each?

24. On a farm there are 125 animals—horses, cows and sheep. For each horse there are 4 cows, and for each cow there are 5 sheep. How many of each are there?

25. Mary is $\frac{4}{7}$ as old as Ella, and the sum of their ages is 9 years less than twice the age of Ella. What are their ages?

26. The age of Nellie is $\frac{3}{4}$ the age of Fannie, and the sum of their ages is 25 years less than 3 times the age of Fannie. How old is each?

27. Alice is $\frac{2}{3}$, and Emma $\frac{1}{2}$ as old as Bessie. The sum of their ages is $\frac{3}{4}$ of their father's age, which is 52 years. How old is each?

28. A has $\frac{1}{3}$ as much money as B; B has $\frac{1}{4}$ as much as C; C has $66 more than A. How much have they altogether?

29. On counting their money, it was found that Edgar had 18 cents more than Andrew, and that $\frac{1}{3}$ of Edgar's = $\frac{2}{5}$ of Andrew's. How much had each?

30. A horse, buggy, and harness cost $100. The buggy cost $\frac{7}{9}$ as much as the horse, and the harness $\frac{4}{7}$ as much as the buggy. Find the cost of each.

31. A mother is 35 years older than her daughter. The daughter's age is $\frac{3}{10}$ of the mother's. What is the age of each?

32. Russell and Morgan together bought a farm. $\frac{3}{5}$ of Russell's share $=\frac{6}{18}$ of Morgan's. If Morgan had 15 acres more than Russell, how many had each?

33. D has $20 less than C, and $\frac{2}{3}$ of D's $=\frac{4}{11}$ of C's. How much has each?

34. A has 25 cents more than B, and $\frac{4}{5}$ of B's $=\frac{8}{15}$ of A's. How much has each?

35. C has $35 less than D, and $\frac{4}{9}$ of C's $=\frac{8}{25}$ of D's. How much has each?

36. William's age is $2\frac{3}{4}$ times Frank's, and the sum of their ages is 45 years. How old is each?

37. Anna's age is $\frac{4}{5}$ of Lucy's, and $\frac{2}{3}$ of both their ages is $\frac{6}{7}$ of the age of Mary, which is 28 years. How old are Anna and Lucy?

38. Smith's money is $\frac{7}{9}$ of Brown's, and $\frac{3}{8}$ of all their money is $\frac{6}{5}$ of Robinson's, who has $100. How much have Smith and Brown?

39. A drover's sheep are in 3 fields. The second contains 3 times as many as the first, and the third contains twice as many as the second, or 50 more than both first and second. How many are in each field?

40. There are three pieces of cloth. The second contains $\frac{5}{7}$ as many yards as the first, and $\frac{5}{6}$ of what they both contain is $\frac{8}{5}$ of what the third contains, which is 25 yards. How many yards are in the first and second pieces?

41. A farmer's land lies in three tracts. The second contains 5 times as many acres as the first, and the third contains twice as many as the second, or 60 more than both first and second. How many acres does each contain?

42. A drover sold $\frac{5}{12}$ of his hogs. He then bought

$\frac{2}{7}$ as many as he had remaining, after which he had 63 hogs. How many had he at first?

43. A huckster sold $\frac{13}{25}$ of his turkeys. He then bought $\frac{2}{3}$ as many as he had left, after which he had 80 turkeys. How many had he at first?

44. A merchant gained $\frac{7}{20}$ of his capital the first year, and $\frac{2}{9}$ of that amount the second year. The third year he lost $\frac{3}{11}$ of all his money, and found that he had $1200. What was his original capital?

LESSON II.

1. Divide 92 into two parts, so that $\frac{5}{8}$ of the first — 12, shall equal the second.

Solution: The first part is $\frac{8}{8}$, the second is $\frac{5}{8} - 12$. The sum is $\frac{13}{8}$ of the first — 12, which $= 92$. Then $\frac{13}{8}$ of the first $= 92 + 12 = 104$. $\frac{1}{8} = 8$, $\frac{8}{8} = 64$. $\frac{5}{8} - 12 = 28$. *Answer:* 1st, 64; 2d, 28.

2. Divide 120 into two such parts, that $\frac{3}{8}$ of the first — 1 shall = the second.

3. Divide 100 into two parts, so that $\frac{3}{5}$ of the first + 4 shall = the second.

4. Divide 140 into two parts, so that $\frac{7}{8}$ of the first + 5 shall = the second.

5. If to Mr. Smith's age you add its $\frac{3}{4}$ and its $\frac{5}{8}$ + 30 years, his age will be trebled. How old is he?

6. If I had $\frac{3}{5}$ as many dollars more, and $10 besides, I would have $70. How much money have I?

7. If I had $\frac{3}{4}$ as many bushels more, and $3\frac{1}{2}$ bushels besides, I would have 49 bu. of corn. How much have I?

8. The sum of the ages of Alice and Robert is 41 years. Robert is twice as old as Alice — 7 years. How old is each?

9. The sum of the ages of Mary and Frank is 38 yr. Mary is twice as old as Frank + 2 yr. How old is each?

10. Albert is twice as old as Oliver + 9 yr. If their united ages = 39 yr., how old is each?

11. Agnes is 3 times as old as Maggie — 8 yr., and the difference of their ages is 12 yr. How old is each?

12. If $12 be added to $\frac{3}{5}$ of A's money, the sum will = B's. Together they have $100. How much has each?

13. If $12 be subtracted from $\frac{4}{5}$ of A's money, the remainder will = B's. Together they have $87. How much has each?

14. If $\frac{3}{4}$ of a farmer's sheep were increased by 8, the sum would equal the number of his hogs. If they together number 99, how many of each are there?

15. B's age is $\frac{5}{7}$ of A's—10 years, and the sum of their ages is 74 years. How old is each?

16. Charles' age is $\frac{6}{5}$ of John's, and $\frac{3}{4}$ of John's + 9 yr. = Charles'. What is the age of each?

17. $\frac{3}{4}$ of C's money = $\frac{6}{7}$ of D's, and $\frac{4}{5}$ of their difference is $16. How much money has each?

18. $\frac{2}{3}$ of E's money = $\frac{3}{4}$ of F's, and $\frac{5}{8}$ of their difference is $25. How much has each?

19. $\frac{3}{5}$ of A's land = $\frac{9}{10}$ of B's, and $\frac{2}{3}$ of their sum is 100 acres. How many acres has each?

20. $\frac{5}{4}$ of Brown's sheep = $\frac{10}{7}$ of Smith's, and $\frac{6}{5}$ of their sum = 144. How many sheep has each?

21. Belle's age is $\frac{4}{5}$ of Eliza's, and $\frac{7}{12}$ of both their ages—6 yr. = $\frac{3}{2}$ of the age of Susan, which is 10 years. How old are Belle and Eliza?

22. A has $\frac{1}{3}$ as much money as B. B has $\frac{1}{5}$ as much as C. If A has $28 less than C, how much has B?

23. If I had $\frac{2}{3}$ as many dollars more, and $7\frac{1}{2}$ besides, I would have $67\frac{1}{2}$. How much have I?

24. My age + its $\frac{3}{4}$ and its $\frac{2}{3}$ + 21 years = 3 times my age. How old am I?

25. In an orchard of apple, plum, and cherry trees, 80 in all, the plum trees = $\frac{5}{8}$ of the apple trees, and the cherry trees = $\frac{1}{4}$ of the apple trees + $\frac{1}{5}$ of the plum. How many of each kind are there?

26. A farmer raised 75 geese, ducks, and chickens. There were $\frac{2}{3}$ as many ducks as geese, and the number of chickens = $\frac{1}{2}$ the number of geese and ducks together. How many were there of each?

27. B's money + $10 = $\frac{5}{8}$ of A's. Together they have $68. How much has each?

28. C's money = $\frac{5}{8}$ of D's, and $\frac{2}{5}$ of C's + $36 = D's. How much has each?

29. George bought a watch, a chain, and a ring for $70. The chain cost 6 dollars less than the ring, and the watch $28 more than the chain. Find cost of each?

30. I bought a stove, a carpet, and a lounge for $75. The carpet cost $20 more than the stove, and the lounge $25 less than the carpet. What did each cost?

31. C has twice as much money as B + $4. D has as much as B and C + $6. Together they have $74. How much has each?

32. B has twice as much money as A + $5. C has as much as A and B + $30. Together they have $100. How much has each?

33. John has twice as much money as James — $8. Frank has as much as John and James — $12. Together they have $50. How much has each?

34. B has twice as much land as A — 5 acres. C has as much as A and B — 7 acres. Together they have 67 acres. How much land has each?

35. Henry is 3 times as old as William — 10 yr.

Isaac is twice as old as both — 30 yr. The sum of their ages is 60 yr. How old is each?

36. A watch, a chain, and a pin cost $240. The chain cost $40 less than the pin, and the watch $20 more than both chain and pin. What did each cost?

37. A horse, mule, and cow cost $280. The mule cost $40 more than the cow, and the horse $20 more than both mule and cow. What did each cost?

38. A, B, and C own 150 acres of land. A owns 30 acres less than B, and C owns 10 acres more than both A and B. How many acres has each?

39. Bought a horse, buggy, and harness for $330. The harness cost $40 less than the horse, and the buggy $50 more than both horse and harness. What did each cost?

40. Joseph has $16 more than William, and $\frac{4}{7}$ of William's equals $\frac{12}{25}$ of Joseph's. How much has each?

41. A has $\frac{2}{3}$ as much money as B. B has $\frac{3}{4}$ as much as C. If C has $20 more than A, how much have all?

42. The head of a fish is 5 inches long. The tail is as long as the head + $\frac{1}{3}$ of the body, and the body is as long as both head and tail. How long is the fish?

43. A fish's head weighs 3 pounds. The tail weighs as much as the head + $\frac{1}{4}$ of the body, and the body weighs as much as both head and tail. What is the weight of the fish?

44. John's age is 6 yr. His brother is 3 yr. older + $\frac{1}{5}$ the age of their father, and the father is twice as old as both. What is the age of each?

LESSON III.

1. If a man can mow a meadow in 3 days, what part of it can he mow in one day?

Solution: He can mow such a part of it as 1 day is a part of 3 days, which is $\frac{1}{3}$. *Answer:* $\frac{1}{3}$ of it.

2. A laborer can build a wall in 5 days. What part of it can he build in 4 days?

3. If a horse can trot a certain distance in $3\frac{3}{4}$ hours, what part of it can he trot in 1 hour?

4. If a man can walk from Cleveland to Cincinnati in $12\frac{1}{2}$ days, what part of the distance can he walk in 5 days?

5. A can do $\frac{1}{2}$ of a piece of work in a day, and B $\frac{2}{5}$ of it. What part of the work can both do in a day?

6. A can do $\frac{1}{3}$, B $\frac{1}{4}$, and C $\frac{1}{6}$ of a piece of work in a day. In what time can all do the work?

Solution: A can do $\frac{4}{12}$, B $\frac{3}{12}$, C $\frac{2}{12}$ of the work in a day. The sum is $\frac{9}{12}$, or $\frac{3}{4}$, of the work, or they can do the work in $\frac{4}{3} = 1\frac{1}{3}$ days.

7. A and B can do a piece of work in 4 days; A alone in 6 days. In what time can B do the work?

8. A, B, and C can do a piece of work in 6 days; A and B together in 10 days; and A alone in 25 days. In what time can B or C do it?

9. A can do a piece of work in $\frac{1}{2}$ day, B in $\frac{1}{3}$ day, C in $\frac{1}{5}$ day. In what time can all do the work?

10. A can do a piece of work in $\frac{1}{2}$ day, B in $\frac{3}{4}$ day, C in $\frac{3}{5}$ day. In what time can all do the work?

11. A can do $\frac{2}{3}$ of a piece of work in a day; B $\frac{5}{6}$ of it. In what time can both do it?

12. A can do $\frac{3}{2}$ of a piece of work in a day; B $\frac{3}{4}$ of it. In what time can both do it?

13. A can do $\frac{9}{10}$ of a piece of work in a day; B $\frac{3}{2}$ of it. In what time can both do it?

14. A can do 2 times a piece of work in a day; B $\frac{2}{3}$ of it. In what time can both do it?

15. A can do a piece of work in a day; B $\frac{2}{3}$ of it. In what time can both do it?

16. A can do a piece of work in 1 day, B in 3 days. In what time can both do it?

17. A can do a piece of work in $2\frac{1}{3}$ days, B in 1 day. In what time can both do it?

18. A can do a piece of work in 2 days, B in $2\frac{1}{2}$ days. In what time can both do it?

19. A can do a piece of work in $3\frac{1}{2}$ days, B in $2\frac{1}{3}$ days. In what time can both do it?

20. A can do a piece of work in $1\frac{1}{2}$ days, B in $2\frac{1}{4}$ days. In what time can both do it?

21. A can do a piece of work in $\frac{2}{3}$ days; B can do $\frac{2}{3}$ of the work in a day. In what time can both do the work?

22. A can do a piece of work in $\frac{4}{5}$ days; B can do $\frac{3}{4}$ of the work in a day. In what time can they together do the work?

23. A can do a piece of work in $1\frac{1}{2}$ days; B can do $\frac{1}{2}$ of the work in a day. In what time can both do a piece 5 times as large?

24. A can do a piece of work in $\frac{3}{4}$ of a day; B can do $\frac{2}{3}$ of the work in a day. In what time can both do a piece twice as large?

25. A can do a piece of work in $3\frac{1}{5}$ days; B can do $\frac{3}{8}$ of the work in a day. In what time can both do a piece $5\frac{1}{2}$ times as large?

26. A can do a piece of work in 4 days; B a piece 3 times as large in 8 days. In what time can both do a piece 4 times as large as the first?

27. A can do a piece of work in 3 days; B a piece 4 times as large in 15 days. In what time can both do a piece 6 times as large as the first?

28. A can do a piece of work in $4\frac{1}{6}$ days; B a piece twice as large in 5 days. In what time can both do a piece 4 times as large as the first?

29. A can do a piece of work in $2\frac{4}{7}$ days; B a piece 4 times as large in 9 days. In what time can both do a piece 6 times as large as the first?

30. A can do a piece of work in $3\frac{3}{4}$ days; B a piece 2 times as large in 5 days. In what time can both do a piece 8 times as large as the first?

31. A and B together can do a piece of work in 15 days. They work 9 days, when A leaves, and B completes it in 18 days more. In what time could each do it alone?

32. A and B together can do a piece of work in 12 days. They work 3 days, when B leaves, and A finishes it in 15 days more. In what time could each do the work?

LESSON IV.

1. The time past noon $= \frac{2}{3}$ of the time to midnight. What is the time of day?

Solution: The time to midnight $= \frac{3}{3}$. Then $\frac{2}{3} + \frac{3}{3}$, or $\frac{5}{3}$ of the time to midnight $= 12$ hr. $\frac{1}{3} = 2\frac{2}{5}$ hr., and $\frac{2}{3} = 4\frac{4}{5}$ hr. *Answer:* $4\frac{4}{5}$ hr. p. m.

2. The time past noon $= \frac{4}{5}$ of the time to midnight. What is the hour?

3. The time past noon $= \frac{7}{8}$ of the time to midnight. What is the hour?

4. $\frac{1}{8}$ of the time past noon $= \frac{1}{7}$ of the time to midnight. What o'clock is it?

5. $\frac{4}{5}$ of the time past noon $= \frac{4}{11}$ of the time to midnight. What is the time?

6. $\frac{3}{4}$ of the time past noon $= \frac{6}{7}$ of the time to midnight. What is the hour?

7. The time past noon $= \frac{1}{3}$ of the time past midnight. What o'clock is it?

Solution: If the time past noon equals $\frac{1}{3}$ of the time past midnight, the time from midnight to noon, which is 12 hr. = the remaining $\frac{2}{3}$ of it. If 12 hr. are $\frac{2}{3}$, $\frac{1}{3}$ is $\frac{1}{2}$ of 12 hr. = 6 hr. *Answer:* 6 o'clock p. m.

8. The time past noon $= \frac{5}{14}$ of the time past midnight. What is the hour?

9. The time past noon $= \frac{4}{19}$ of the time past midnight. What time is it?

10. $\frac{2}{3}$ of the time past noon $= \frac{6}{25}$ of the time past midnight. What is the hour?

11. $\frac{4}{5}$ of the time past noon $= \frac{8}{25}$ of the time past midnight. What is the time?

12. If the time past midnight $= \frac{3}{5}$ of the time to noon, what o'clock is it?

13. If the time past midnight $= \frac{2}{7}$ of the time to noon, what is the hour?

14. If the time past midnight $= \frac{3}{5}$ of the time to midnight again, what is the time?

15. If the time past midnight $= \frac{5}{7}$ of the time to midnight again, what is the hour?

16. The time past noon + 4 hr. $= \frac{2}{3}$ of the time to midnight. What time is it?

Solution: Let the time past noon = 1. Then, 1 + 4 hr. $= \frac{2}{3}$ of the time to midnight, and the time to midnight $= \frac{3}{2}$ (1 + 4 hr.) $= \frac{3}{2} + 6$ hr. The time past noon $= \frac{2}{2}$. Then $\frac{5}{2}$ of the time past noon + 6 hr. = 12 hr., and $\frac{5}{2}$ of the time past noon = 12 — 6, or 6 hr. $\frac{1}{2} = \frac{6}{5}$, and $\frac{2}{2} = \frac{12}{5} = 2\frac{2}{5}$ hr. *Answer:* $2\frac{2}{5}$ hr. p. m.

17. The time past noon — 4 hr. = $\frac{4}{5}$ of the time to midnight. What is the hour?

18. The time past noon + 3 hr. = $\frac{3}{5}$ of the time to midnight. What o'clock is it?

19. The time past noon — 6 hr. = $\frac{3}{5}$ of the time to midnight. What is the hour?

20. The time past noon + 10 hr. = $\frac{5}{3}$ of the time to midnight. What time is it?

21. At what time between 3 and 4 o'clock are the hour hand and minute hand of a watch exactly together?

Solution: At 3 o'clock the min. hand is at XII, and the hr. hand at III; therefore the min. hand *must gain* 15 *minute-spaces + the distance the hr. hand moves*, before the latter is overtaken. Now, the min. hand moves over 60 minute-spaces, while the hr. hand moves over 5. Consequently it will move 12 minute-spaces, while the hr. hand moves 1. Then on each 12 minute-spaces that the min. hand moves, it *gains* 12 — 1, or 11 spaces on the hr. hand. But the 12 min. that it moves are $\frac{12}{11}$ of the distance gained. Therefore it must move $\frac{12}{11}$ of 15, or $16\frac{4}{11}$ minute-spaces to overtake the hr. hand. *Answer:* $16\frac{4}{11}$ min. after 3 o'clock.

Remark: The above solution suggests this formula: To find when the hands will be *together*, take $\frac{12}{11}$ of the number of minutes between the figure XII and the *first* of the other hours named. To find when they will be *opposite*, take $\frac{12}{11}$ of the number of min. between the figure XII and the figure on the dial *opposite* to the first of the other hours named.

22. At what time between 2 and 3 o'clock will the hands of a clock be together? At what time opposite?

23. At what time between 7 and 8 o'clock will the hands of a watch be together? At what time will they be opposite?

24. At what time between 10 and 11 o'clock will the hands of a clock be together? At what time opposite?

25. At what time between 5 and 6 o'clock will the hands of a watch be together? *Can* they be opposite *between* 5 and 6? Why?

LESSON V.

1. Divide 45 chestnuts between Anna and Alice, so that Anna may get 5 as often as Alice receives 4.

Solution: $5 + 4 = 9$, of which Anna's part is $\frac{5}{9}$, and Alice's $\frac{4}{9}$. $\frac{5}{9}$ of $45 = 25$, and $\frac{4}{9}$ of $45 = 20$. Therefore Anna receives 25, and Alice 20 chestnuts.

2. A man and his son together earned $50, and for every $3 that the boy earned the man earned $7. How much did each earn?

3. In a school of 39 pupils there are 7 boys to 6 girls. What is the number of each?

4. In a pasture there are 56 sheep and cows, and the number of cows is to the number of sheep as 5 is to 9. How many are there of each?

5. The sum of the ages of Harry and his father is 60 years, and the father's is to Harry's as 11 is to 4. What are their ages?

6. Divide 64 into 3 parts, having the ratios of 2, 5, and 9.

7. Two men rented a meadow for $48. The first pastured 5 cows, and the second 7 cows. What should each pay?

8. A and B bought a carriage for $120. A paid $75, B the remainder. They sold it for $160. What did each receive?

9. C and D bought a boat for $500. C paid $350, D the remainder. They sold it for $400. How much did *each lose?*

10. A house worth $2400, and insured for $1800, was destroyed by fire. If A owned $\frac{1}{4}$, B $\frac{1}{3}$, and C the remainder, what was the loss of each?

11. Divide 70 into two parts that shall be to each other as $2\frac{1}{2}$ to $3\frac{1}{3}$.

Solution: $2\frac{1}{2} + 3\frac{1}{3} = 5\frac{5}{6}$, or $\frac{35}{6}$. Then $\frac{1}{6} = 2$, $\frac{15}{6} = 30$, $\frac{20}{6} = 40$. *Answer:* 30 and 40.

12. Divide 48 marbles between Herman and Henry, so that their shares shall be to each other as $3\frac{1}{2}$ to $4\frac{1}{2}$.

13. A and B bought a horse. A paid $\$3\frac{3}{4}$ as often as B paid $\$2\frac{1}{4}$. They sold him for $120. What did each receive?

14. C and D together bought 480 bu. of wheat, and C paid $1\frac{2}{5}$ times as much as D. What number of bu. did each buy?

15. Divide $54 between C and D so that their shares shall have the ratio of $\frac{3}{5}$ to $\frac{3}{4}$.

16. The sum of two numbers is 100, and the first is to the second as $\frac{3}{10}$ is to $\frac{8}{15}$. What are the numbers?

17. A, B, and C together earned $99, and their shares respectively were in the ratio of $\frac{3}{4}$, $\frac{3}{5}$, and $\frac{3}{10}$. How much did each earn?

18. $\frac{3}{4}$ of A's money $= \frac{12}{25}$ of B's, and $\frac{2}{3}$ of their difference is $30. How much has each?

19. A tree 85 ft. high was broken into 3 pieces. The middle part was to the top part as 3 is to 4, and the lower part was to the middle part as 1 is to 2. What was the length of each part?

20. On a farm there are 150 fowls—geese, turkeys, and chickens. The turkeys are to the chickens as 5 is to 8, and the geese are to the turkeys as 2 is to 5. How many are there of each?

21. E and F bought a horse for $80. E paid $36, F the remainder. They sold him for $100. What did each *gain?*

22. The ratio of $8\frac{1}{3}$ to $37\frac{1}{2}$ = the ratio of $3\frac{1}{3}$ to what number?

23. A's land is to B's as $1\frac{3}{4}$ is to $2\frac{1}{4}$, and they together own 80 A. If A's should be sold at $50 an acre, and B's at $40 an acre, how much more would B receive than A?

24. A's money is to B's as $\frac{2}{3}$ is to $\frac{4}{9}$, and $\frac{4}{5}$ of what they both have = $100. How much has each?

25. Bought a number of geese at 50 ct. each, and twice as many turkeys at 75 ct. each. If I paid $50 for the lot, how many of each did I buy?

26. A farmer raised twice as many bu. of barley as of wheat, and twice as many bu. of oats as of barley. He sold the wheat at $1 a bu., the barley at 50 ct., and the oats at 25 ct. If he sold all for $150, how many bu. of each did he raise?

LESSON VI.

1. The sum of two numbers is 30, and the greater exceeds the less by 12. What are the numbers?

Suggestion: The sum + the difference = twice the greater; or, the sum — the difference = twice the less. *Answer:* 21 and 9.

2. The sum of two numbers is 39, and the greater exceeds the less by 1. What are the numbers?

3. The difference of two numbers is 16, and the greater added to the less = 50. What are the numbers?

4. Henry has 20 cents more than Robert, and together they have $1. How much has each?

5. Smith is 15 years younger than Brown, and the sum of their ages is 69 years. How old is each?

6. A and B each had the same number of sheep, but *A bought* 10 more, and they then together had 88 sheep. *How many* belonged to each?

7. C and D owned an equal number of acres, but C sold 20 acres, and D 25 acres. They then had 155 acres. How many had each remaining?

8. Two men began business, each with the same sum. The first gained $60, and the second lost $50. They then together had $510. What sum had each then?

9. Ned had twice as many marbles as Tom, but Ned lost 10, and Tom won 16. They then had 81 marbles. How many belonged to each?

10. If 27 be added to $\frac{5}{8}$ of a certain number, the result will be 62. What is the number?

11. If 13 be subtracted from $\frac{3}{5}$ of a certain number, the remainder will be 32. What is the number?

12. If 15 be added to $\frac{4}{9}$ of a certain number, and the sum multiplied by 3, the product will be 105. What is the number?

13. If 18 be subtracted from $\frac{7}{12}$ of a certain number, and the remainder divided by 2, the quotient will be 26. What is the number?

14. George had three times as much money as Samuel. He spent $\frac{2}{5}$ of it, then earned $5, and had $50. How much had each at first?

15. A horse and buggy cost $175, and $\frac{4}{5}$ of the cost of the buggy + $20 = $\frac{4}{5}$ of the cost of the horse. What did each cost?

16. A's age is twice B's, and A's age diminished by 6 years = $1\frac{3}{4}$ times B's. How old is each?

17. The distance from A to B is three times the distance from C to D, and $1\frac{1}{2}$ times the distance from A to B — 35 miles = the distance from C to D. How far is it from A to B, and from C to D?

18. A and B together cut 48 cords of wood, and $\frac{5}{9}$ of what A cut + 6 cords = the number that B cut. How many cords did each cut?

19. Joseph spent $\frac{3}{8}$ of his money + \$5, and had $\frac{3}{5}$ of his money remaining. How much money had he at first?

20. A farmer sold $\frac{7}{12}$ of his sheep — 15, and found that he had $\frac{5}{9}$ of his sheep remaining. How many sheep did he sell?

21. A planter sold $\frac{7}{10}$ of his land + 12 acres, and then had 33 acres remaining. How many acres had he at first?

22. A poulterer bought $\frac{2}{3}$ as many chickens as he already had — 50, and then had 150. How many chickens had he at first?

23. $\frac{3}{5}$ of A's money — \$9 = $\frac{9}{10}$ of B's. Together they have \$115. How much has each?

24. $\frac{2}{3}$ of A's age + 16 years = $\frac{6}{7}$ of B's. The sum of their ages is 56 years. How old is each?

25. $\frac{3}{4}$ of A's money — \$21 = $\frac{6}{11}$ of B's. Together they have \$180. How much has each?

26. $\frac{2}{5}$ of Rob's marbles + 10 = $\frac{4}{3}$ of Carl's, and their difference is 24. How many marbles has each?

27. $\frac{4}{9}$ of a certain number, increased by 15 = $\frac{5}{6}$ of the same number, diminished by 20. What is the number?

28. $\frac{7}{10}$ of a certain number, diminished by 12 = $\frac{8}{15}$ of the same number, increased by 13. What is the number?

LESSON VII.

1. If 12 men can do a piece of work in $8\frac{1}{3}$ da., in what time can 10 men do a piece $2\frac{1}{2}$ times as large?

2. If 5 men can do a piece of work in 6 da., how many men can do a piece twice as large in 4 da.?

3. If 6 men can do a certain work in 8 da., how many more men should be employed to complete it in $5\frac{1}{3}$ da.?

4. If 10 men can build a wall in 6 da., how much longer would it occupy 8 men?

5. If 12 men can do a piece of work in $6\frac{1}{4}$ da., how many men can do a piece twice as large in $\frac{3}{4}$ of the time?

Solution: To do a piece twice as large in the same time, will require 2 times 12, or 24 men. And to do it in $\frac{3}{4}$ of the time will require $\frac{4}{3}$ of 24 men $= 32$ men. *Answer:* 32 men.

Remark: In the solution of problems like the last, the number of days need not be considered. The answer would be the same if any other number or *no* number of days was given.

6. If 9 men can do a piece of work in 10 da., how many can do a piece 5 times as large in $\frac{3}{5}$ of the time?

7. If 12 men can do a piece of work in a certain time, how many can do a piece 3 times as large in $\frac{4}{5}$ of the time?

8. If 9 men can do a piece of work in a certain time, how many can do a piece $\frac{2}{3}$ as large in $\frac{3}{4}$ of the time?

9. If 10 men can do a piece of work in 6 da., in what time can it be done if 2 more men assist them when the work is half completed?

Solution: 1 man can do the work in 60 da., or $\frac{1}{60}$ of the work in a da. When the work is half completed, they have worked $\frac{1}{2}$ of 6 da., or 3 da., and done $\frac{30}{60}$ of the work, leaving $\frac{30}{60}$ to be done. Then, if 2 more men assist them, there will be 12 men employed. If 1 man does $\frac{1}{60}$, 12 men will do $\frac{12}{60}$, and to do $\frac{30}{60}$ will require $\frac{30}{60} \div \frac{12}{60} = 2\frac{1}{2}$ da. This added to 3 da. $= 5\frac{1}{2}$ da.

10. If 8 men can do a piece of work in 6 da., in what time can it be done if 2 of them leave when the work is half completed?

11. If 12 men can do a certain work in 6 da., in what

time can it be done if 4 more men assist them when the work is $\frac{2}{3}$ completed?

12. If 8 men can do a piece of work in 5 da., in what time can it be done if 3 of them leave when the work is $\frac{3}{4}$ completed?

13. A and B together can do a piece of work in 6 da. A alone in 10 da. In what time can B do the work?

14. A and B together can mow a meadow in $3\frac{1}{3}$ da. B alone in $7\frac{1}{2}$ da. In what time can A mow it?

15. C and D together can dig a cellar in $7\frac{1}{2}$ da. D alone in 12 da. In what time can C do it?

16. A and B together can do a piece of work in 18 da. They work 6 da., when A leaves, and B finishes it in 30 da. more. In what time could each do it?

17. C and D together can do a piece of work in 10 da. They work 4 da., when D leaves, and C finishes it in 15 da. more. In what time can each do it?

18. If 4 oxen can eat 3 bu. of corn in 2 da., in how many da. can 8 oxen eat 10 bu.?

19. If 8 horses can eat 5 acres of grass in 10 da., in what time can 12 horses eat 9 acres?

20. If 6 men can weave 4 carpets in 5 da., in how many da. can 10 men weave 9 carpets?

21. If 9 oxen eat 4 acres of grass in 8 da., in how many da. can 12 oxen eat 5 acres?

22. If 12 horses consume \$3 worth of corn in 5 da., how many horses will consume \$6 worth in 15 da.?

23. If 15 oxen can be pastured on 5 acres for 6 da., how many can be pastured on 4 acres for 8 da.?

24. 8 men can build 3 miles of fence in 9 da., how many miles can 10 men build in 5 da.?

25. If 12 oxen consume 9 acres of grass in 15 da., in how many da. would 8 oxen consume 10 acres?

26. If 18 oxen can be kept on 6 acres for 4 mo., how many sheep can be kept on 10 acres for 8 mo., if 5 sheep eat as much as 1 ox?

Solution: $\frac{1}{6}$ of 18 oxen, or 3 oxen, can be kept on 1 acre for 4 mo.; 4 times 3 oxen, or 12 oxen, can be kept on 1 acre for 1 mo.; 10 times 12 oxen, or 120 oxen, can be kept on 10 acres for 1 mo.; $\frac{1}{8}$ of 120 oxen, or 15 oxen, can be kept on 10 acres for 8 mo.; 15 times 5 sheep, or 75 sheep, can be kept on 10 acres for 8 mo., if 5 sheep eat as much as 1 ox. *Answer:* 75 sheep.

27. If 21 oxen can be kept on 7 acres for 5 mo., how many sheep can be kept on 10 acres for 6 mo., if 8 sheep eat as much as 1 ox?

28. If 25 horses can be kept on 5 acres for 4 da., how many sheep can be kept on 6 acres for 8 da., if 10 sheep eat as much as 1 horse?

29. If 30 oxen can be kept on 15 acres for 4 mo., how many sheep can be kept on $12\frac{1}{2}$ A. for 10 mo., if an ox eat as much as 7 sheep?

30. If 12 men can hoe 4 acres of corn in 3 hours, how many boys can hoe 8 acres in 2 hours, if 2 men do as much work as 3 boys?

LESSON VIII.

1. A and B rented a meadow for $30. A pastured 6 cows, and B 9 cows. What should each pay?

Solution: Together they pastured 6 + 9, or 15 cows, of which A's part was $\frac{6}{15}$, or $\frac{2}{5}$, and B's $\frac{9}{15}$, or $\frac{3}{5}$. Therefore A should pay $\frac{2}{5}$ of $30, or $12, and B $\frac{3}{5}$ of $30, or $18. *Answer:* A should pay $12; B, $18.

2. A and B rented a pasture for $50. A put in 8 horses, and B 18 cows. What should each pay if 2 horses eat as much as 3 cows?

3. C and D rented a field for $48. C pastured 5 cows 8 weeks, D 18 sheep 5 weeks. What should each pay if 4 cows eat as much as 15 sheep?

Solution: 5 cows for 8 wk. = 40 cows for 1 wk. 18 sheep for 5 wk. = 90 sheep for 1 wk. If 4 cows eat as much as 15 sheep, D's 90 sheep will = as many times 4 cows as 15 sheep are contained times in 90 sheep = 6, and 6 × 4 cows = 24 cows. Then, 40 + 24 = 64 cows, of which C's part is $\frac{40}{64}$, or $\frac{5}{8}$, and D's $\frac{24}{64}$, or $\frac{3}{8}$. Hence, C pays $\frac{5}{8}$ of \$48, or \$30, and D $\frac{3}{8}$ of \$48, or \$18. *Answer:* C pays \$30; D, \$18.

4. E and F rented a pasture for \$144. E put in 5 horses for 6 mo., F 8 cows for 7 mo. What should each pay if 3 horses eat as much as 4 cows?

5. C and D rented a field for \$168. C pastured 9 horses for 4 mo., D 12 cows for 6 mo. What should each pay if 2 horses eat as much as 3 cows?

6. A and B rented a pasture for \$108. A put in 10 horses, B 16 cows and 60 sheep. What should each pay if a horse eat as much as 12 sheep, and 3 horses as much as 4 cows?

7. E and F rented a field for \$90. E put in 8 horses for 3 mo., F 20 oxen for 2 mo. What should each pay if 3 horses eat as much as 5 oxen?

8. A and B rented a meadow for \$75. A pastured 16 horses, B 20 oxen and 54 sheep. What should each pay if a horse eat as much as 6 sheep, and 3 horses as much as 4 oxen?

9. A and B rent a field for \$51. A put in 10 horses, B 16 cows and 96 sheep. What should each pay if a horse eats as much as 12 sheep, and 3 horses as much as 4 cows?

10. C and D rented a meadow for \$60. C put in 6 horses for 3 mo., and D 9 cows for 5 mo. What should each pay if 4 horses eat as much as 5 cows?

11. A, B, and C rented a pasture for $160. A pastured 5 horses for 4 mo., B 8 cows for 7 mo., C 24 sheep for 6 mo. What should each pay if a horse eat as much as 8 sheep, and 3 horses as much as 4 cows?

12. A, B, and C rented a pasture for $50. A put in 5 horses for 4 mo., B 15 cows for 3 mo., C 30 sheep for 5 mo. What should each pay if 2 horses eat as much as 3 cows, or as much as 6 sheep?

13. A and B entered into partnership. A put in $300 for 7 mo., and B $400 for 6 mo. They gained $450. What was the share of each?

14. A and B were partners. A contributed $500 for 8 mo., and B $600 for 10 mo. They lost $250. How much did each lose?

15. A and B went into partnership for 15 mo. A put in $300, B $400. How much more must A put in at the end of 9 mo. to receive half of the profits?

16. C and D entered into partnership for 1 year. C put in $300, and D $500. How much more must D put in at the end of 7 mo. to entitle him to half of the profits?

17. E and F went into partnership for 16 mo. E contributed $300, and F $250. How much must E withdraw at the end of 12 mo. to entitle F to half of the profits?

18. A, B, and C contracted to build a house for $2250. A sent 4 men for 25 da., B 5 men for 30 da., C 10 men for 20 days. What should A, B, and C each receive?

19. A and B entered into partnership for 1 year, with a joint capital of $2000. They gained $800, A's share being $200 more than B's. How much did each contribute?

20. C's capital was to D's as 5 to 8. C's was employed 12 mo., and D's 9 mo. They gained $990. How did they divide it?

21. E and F formed a partnership for one year. E at first contributed $600, and at the end of 8 mo. $700 more. F at first put in $1000, but at the end of 4 mo. drew out $500. They gained $1080. What did each gain?

Lesson IX.

1. A is 30 of his own steps ahead of B, and takes 6 steps while B takes 5. But 2 of B's = 3 of A's. How many steps must B take to overtake A?

Solution: If 2 of B's = 3 of A's, 1 of B's = $\frac{3}{2}$ of A's, and 5 of B's = $\frac{15}{2}$ of A's. Then, on each 5 steps that B takes he *gains* $7\frac{1}{2}-6=1\frac{1}{2}$ of A's steps, and he must take as many times 5 steps as $1\frac{1}{2}$ are contained times in 30 = 20 times, and 20 times 5 steps = 100 steps. *Answer:* 100 steps.

2. A is 10 of his own steps ahead of B, and takes 5 steps while B takes 4. But 3 of B's = 4 of A's. How many steps must B take to overtake A?

3. A hare is 20 leaps before a hound, and takes 7 leaps while the hound takes 5. But 2 of the hound's = 3 of the hare's. In how many leaps will the hound catch him?

4. John is 15 steps ahead of Robert, and takes 9 steps while Robert takes 8. But 5 of Robert's = 6 of John's. In how many steps will Robert overtake him?

5. A fox is 20 leaps before a hound, and takes 6 leaps while the hound takes 5. But 5 of the hound's = 8 of the fox's. In how many leaps will the hound catch him?

6. Henry is 36 steps before Joseph, but takes only 5 steps while Joseph takes 8. Supposing the length of their steps to be equal, how many steps will Joseph take before he overtakes Henry?

7. A is 10 steps ahead of B, and takes 8 steps while B takes 5. But 3 of B's = 5 of A's. How many steps must B take before he overtakes A?

8. A fox is 80 leaps before a hound, and takes 7 leaps to the hound's 5. If 5 of the fox's = 3 of the hound's, how many leaps will each make before the fox is overtaken?

9. A laborer was employed for 60 da., at $1.75 a da. when he worked, but he was to pay 50 ct. a day for board when idle. If he received $60, how many days did he work?

Solution: Had he worked every day, he would have earned 60 times $1.75 = $105. As he only received $60, he lost $105—$60 = $45. Every idle day cost him $1.75 + $.50 = $2.25. Therefore he was idle as many days as $2.25 are contained times in $45 = 20 days. And he worked 60—20, or 40 days. *Answer:* 40 days.

10. A man agreed to work 40 da. at $2 a day when he worked, and to pay 40 ct. for his board each idle day. If he received $56, how many da. was he idle?

11. A carpenter agreed to work 36 da. at $2.25 a day when he worked, and to pay 75 ct. for board for every day he lost. He received $63. How many da. did he work?

12. A farmer hired a man for 40 da. at $1.75 a day when he worked, but charging him 75 ct. board for each day that he failed to work. If the man received $60, how many days did he work?

13. A mechanic was to receive $2.25 a day for his work, but to forfeit 50 ct. a day when idle. At the end of 36 da. he received $70. How many days did he lose?

14. I was employed 80 da. at $1.37½ a day, but agreed

to forfeit 62½ ct. a day when absent from work. If my wages amounted to $99, how many days did I work?

15. A laborer was hired for a certain time at $1.62½ a day when he worked, but he was to pay 87½ cents a day for board when he was idle. His board cost him $3.50, and he received $68. For how many days was he hired?

LESSON X.

1. B has ¾ as much money as A, but if each had $12 more, B would have ⅚ as much as A. How much money has each?

Solution: Let A's = 1, and B's = ¾. Then, if each had $12 more, A's would be 1 + $12, and B's ¾ + $12. But B's would then equal ⅚ of (1 + $12), or ⅚ + $10. Then, ¾ of A's + $12 = ⅚ of A's + $10. Therefore, the difference between ¾ and ⅚, which is $\frac{1}{12}$ of A's, must = the difference between $12 and $10 = $2. And if $2 is $\frac{1}{12}$ of A's, $\frac{12}{12}$ = $24, and B has ¾ of $24 = $18.

2. C is twice as old as D, but in 10 years more D's age will be ⅗ of C's. How old are they at present?

3. Frank had ⅔ as many marbles as Henry, but each bought 20 more. Frank then had ⅘ as many as Henry. How many had each at first?

4. Said A to B, "My age is ⅗ of yours, but in 9 years from now it will be ⅔ of yours." What were their ages?

5. John had $\frac{7}{10}$ as much money as William, but after John had earned $11, and William had spent $10, each had the same sum. How much had each at first?

6. Eight years ago Harry was ⅓ as old as his father, but 10 years hence he will be $\frac{5}{9}$ as old. What are their ages at present?

7. Albert had 1½ times as many chestnuts as Clif-

ford, but after each had eaten 40, Clifford had only $\frac{2}{5}$ as many as Albert. How many had each left?

8. When Smith was married his wife's age was $\frac{5}{8}$ of his, but 28 years later her age was $\frac{4}{5}$ of his. How old was each when they were married?

9. Moses had three times as many sheep as Aaron, but after Moses sold 15 sheep to Aaron the latter had $\frac{2}{3}$ as many as Moses. How many had each at first?

10. George's money = $\frac{5}{8}$ of Charles', but if Charles should lose $75, and George should find it, each would have an equal amount. How much money has each?

11. A had twice as much land as B, but after B bought 16 acres from A he had $\frac{7}{8}$ as much as A had remaining. How many acres had each then?

LESSON XI.

1. If I buy a certain number of sheep at $5 each, I will have $12 left; but to buy the same number of hogs at $9 each requires $28 more than all my money. How many sheep could I buy, and how much money have I?

Solution: The difference between paying $5 or $9 apiece is $4, and the difference between having $12 left and not having sufficient money by $28 is $40. Then I could buy as many sheep as $4 is contained times in $40 = 10 sheep. Also, 10 sheep at $5 each would cost $50, and if I would have $12 left, my money = $50 + $12 = $62.

2. Albert wishes to divide a number of marbles among his companions. If he gives each of them 8, he will have 10 marbles left; but if he gives each of them 10, he will have none left. How many companions, and how many marbles has he?

3. A lady desires to purchase some silk for a dress. If she pay \$1.25 a yard, she will have \$5 left; but if she pay \$1.50 a yard, she will have only \$2 remaining. How many yards does she want, and how much money has she?

4. To buy wheat at \$1.20 a bu. requires \$8 more than all the money I have; but if I buy the same quantity of corn at 70 ct. a bu. I will have \$12 left. How much money have I?

5. To buy a certain number of sheep at \$3 each requires \$9 less than the money I have; but to buy the same number of hogs at \$4.50 each would require \$15 more than I have. How many do I wish to buy?

6. If a grocer sell his eggs at 12½ ct. a dozen, he will lose 25 ct; but if he charge 18 ct. a dozen, he will gain 30 ct. What did they cost per dozen?

7. By selling my eggs at 16 ct. a dozen, I will gain 28 ct.; but if they be sold at 10 ct. a dozen, I will lose 20 ct. What was the cost per dozen?

8. Sold oranges at 22 ct. a dozen, thereby losing 30 ct. Had I sold them at 30 ct. a dozen, I should have gained 50 ct. Find the cost per dozen.

9. By selling lemons at 20 ct. a dozen, a dealer gained 16⅔ ct.; but had he sold them at 15 ct. a dozen, he would have lost 25 ct. What did he pay for them per dozen?

Review.

LESSON XII.

1. If to a certain number you add its $\frac{3}{4}$ and its $\frac{4}{5} + 45$, the number will be trebled. What is the number?

2. A rides 30 miles in $2\frac{1}{2}$ hr., B 40 mi. in $2\frac{2}{3}$ hr. How far will B go while A rides 52 miles?

3. A can do a piece of work in $\frac{4}{5}$ of a day, B can do the work in a day. In what time can both do a piece 10 times as large?

4. Three men bought a horse for $70. After keeping him six weeks, at 3.33\frac{1}{3}$ a week, and hiring him out for $54, they sold him for $96. What did each gain?

5. If 15 peaches are worth 90 apples, and 7 apples are worth 28 plums, how many plums should be given for 10 peaches?

6. The time past noon — 4 hours $= \frac{2}{3}$ of the time to midnight? What is the time of day?

7. Mary's age is $\frac{8}{5}$ of Nellie's, and the sum of their ages is 12 years more than twice the age of Nellie. How old is each?

8. A has $\frac{7}{9}$ as many chickens as B, and $\frac{4}{7}$ of A's $+ 45$ $=$ B's number. How many chickens has each?

9. A horse, mule, and cow together cost $270. The cow cost $30 less than the mule, and the horse cost $30 more than both mule and cow. What did each cost?

10. A and B together can do a piece of work in $3\frac{3}{4}$ days. If B does $\frac{2}{3}$ as much as A, in what time can each do the work?

11. In a pasture there are 102 sheep and cows, and $\frac{9}{10}$ of the cows $= \frac{3}{8}$ of the sheep. How many of each are there?

12. If 12 horses can be kept on 8 acres for 7 mo., how many mo. will 6 acres supply 9 horses?

13. The age of A is twice the age of B, and $\frac{3}{4}$ of B's age + 36 yr. = $1\frac{1}{2}$ times A's. How old is each?

14. If 10 men can build a wall in 6 da., in what time will it be finished if 10 more men assist them when the work is $\frac{2}{3}$ completed?

15. A man spent $\frac{3}{10}$ of his money. He then borrowed $\frac{5}{7}$ as much as he had remaining, after which he had $84. How much had he at first?

16. A son is 44 yr. younger than his father. The son's age is $\frac{5}{16}$ of the father's. How old is each?

17. Blake has a certain distance to travel. After having gone $13\frac{1}{2}$ miles, there remain $\frac{5}{8}$ of the distance. When he has traveled $\frac{2}{5}$ of the remainder, how far must he then go?

18. A poulterer sold a number of ducks and geese. The geese were $\frac{9}{25}$ of the entire number, or 28 less than the ducks. How many of each did he sell?

19. If Ellis had $\frac{2}{3}$ as many dollars more, and $15 besides, he would have $140. How much has he?

20. A and B travel in opposite directions, A at the rate of 75 miles in $8\frac{1}{3}$ hr., B at the rate of 60 miles in $7\frac{1}{2}$ hr. How far apart will they be when B has traveled 72 miles.

21. Charles is $\frac{5}{12}$ as old as his father, but in 8 years he will be $\frac{1}{2}$ as old. What are their ages at present?

22. C and D rented a pasture for $75. C put in 8 horses for 4 mo., D 10 cows for 6 mo. What should each pay, if 4 horses eat as much as 5 cows?

23. A can do a piece of work in 3 da., B a piece twice as large in 9 da. In what time can both do a piece $3\frac{1}{3}$ times as large as the first?

24. C's chain cost $\frac{3}{8}$ as much as his watch. Twice the price of the watch + 3 times the price of the chain = 5 times the cost of his suit of clothes, which was $50. Find the cost of the watch and the chain.

25. $\frac{3}{4}$ of A's money = $\frac{6}{7}$ of B's, and $\frac{4}{5}$ of their sum is $60. How much has each?

26. If 16 oxen can be kept on 8 acres for 4 mo., how many sheep can be kept on 9 acres for 6 mo., if 10 sheep eat as much as 1 ox?

27. If 25 gal. per hour run into a vessel whose capacity is 60 gal., and 45 gal. run out in 2 hr., in what time will the vessel be filled?

28. If 15 peaches are worth 60 apples, and 7 apples are worth 35 plums, how many plums should be given for 5 peaches?

29. On counting their money it was found that B had $15 less than A, and that $\frac{6}{11}$ of A's = $\frac{3}{4}$ of B's. How much money had each?

30. Charles bought a number of eggs at 1 cent each, and twice as many at $1\frac{1}{2}$ cents each. He sold them at 20 cents a dozen, and gained 50 cents. How many eggs had he?

31. A travels 27 miles in $4\frac{1}{2}$ hr., B 30 mi. in $3\frac{3}{4}$ hr. When A has gone 45 miles, how far is B ahead of him?

32. If $\frac{7}{9}$ of Elmore's money be increased by $40, he will have as much as Curtis. Together they have $200. How much has each?

33. If a five-cent loaf weighs 6 oz. when flour is $5 a barrel, what should be the value of a barrel when the loaf weighs 8 oz.?

34. A laborer agreed to work a certain number of days at $1.75 a day, and to pay 50 cents a day for board when idle. If his board cost him $4, and he received $52 in cash, for how many da. was he hired?

35. A is 24 steps ahead of B, and takes 7 steps while

B takes 6. But 4 of B's = 5 of A's. How many steps must B take to overtake A?

36. The time past noon + 6 hr. = $\frac{3}{2}$ of the time to midnight. What is the time of day?

37. B has twice as much money as A + $4. C has as much as A and B + $10. Together they have $72. How much has each?

38. If 9 oxen can eat 5 acres of grass in 10 days, in how many days can 8 oxen eat 12 acres?

39. If $10 be added to B's money, the sum will = $\frac{5}{8}$ of A's. Together they have $68. How much has each?

40. The age of A is $2\frac{1}{2}$ times the age of B, and $\frac{4}{5}$ of B's age + 32 yr. = $1\frac{3}{5}$ times A's age. How old is each?

41. Harry has $\frac{8}{5}$ as many marbles as Stephen, and $\frac{2}{3}$ of Stephen's + 56 marbles = Harry's number. How many has each?

42. The time past noon = $\frac{7}{8}$ of the time to midnight; also, the time past noon = $\frac{3}{11}$ of the time past midnight. What are the hours?

43. If 11 men can do a piece of work in 17 da., how many can do a piece 5 times as large in $\frac{1}{4}$ of the time?

44. A farmer sold $\frac{4}{9}$ of his hogs. He afterward bought $\frac{3}{5}$ as many as he had remaining, and then had 80 hogs. How many did he sell?

45. If $10 be taken from $\frac{5}{7}$ of C's money, the remainder will = D's. Together they have $50. How much has each?

46. If to Mr. Jones's age its $\frac{1}{2}$, $\frac{3}{5}$, and 36 years be added, his age will be trebled. How old is he?

47. If 14 oxen can be kept on 7 acres for 5 mo., how many sheep can be kept on 9 acres for 6 mo. if 8 sheep eat as much as 1 ox?

48. A and B rented a pasture for $98. A put in 10 horses, B 100 sheep and 21 cows. What should each

pay if a horse eats as much as 10 sheep, and 5 horses as much as 7 cows?

49. A receives 56 cents for $2\frac{1}{8}$ hours' work, B 108 cents for $3\frac{3}{8}$ hours' work. How much will both have earned when B has earned 112 cents?

50. If 12 oranges are worth 60 pears, and 12 pears are worth 60 plums, how many oranges should be given for 500 plums?

51. Bought a number of apples at 2 for 1 cent, and as many more at 3 for 1 cent. By selling all at 3 for 2 cents, I gained 15 cents. How many apples did I buy?

52. If $12\frac{1}{2}$ gal. per minute run into a vat which will hold 150 gal., and $16\frac{2}{3}$ gal. run out in 2 minutes, in what time will the vat be filled?

53. A and B entered into partnership for 15 mo. A put in $250, and B $300. How much more must A put in at the end of 12 mo. to receive half of the profits?

54. A's share of a fortune was $\frac{1}{3}$, B's $\frac{2}{5}$, C's the remainder. If B received $1000 more than C, what was the share of each?

55. A, B, and C rented a pasture for $75. A put in 10 horses for 3 mo., B 8 cows for 5 mo., C 25 sheep for 6 mo. What should each pay, if a horse eat as much as 5 sheep, and 3 horses as much as 4 cows?

56. John bought 5 peaches, James 6, and Henry 9, for which they paid 1 cent apiece. They were joined by Robert, and each ate an equal number. Robert gave the other boys 10 cents for his share. How should the money have been divided?

57. A and B together had 50 cents. A said to B, "Give me 5 cents, and I shall have as much as you have left." How many cents had each?

58. A, B, and C together can do a piece of work in 6 da., A and B in 9 da., and B and C in 12 da. In what time can each do the work?

59. A and B together can build a wall in 18 days. They work 6 days, when A leaves, and B completes it in 30 days more. In what time can each do the work?

60. If I sell my apples at 60 cents a bushel, I will gain $1.20; but if I sell them at 45 cents a bushel, I will lose 30 cents. What was the cost per bushel?

61. A, B, and C divided a sum of money, A's part being $180, which was ⅗ of the sum of B's and C's. If C's share was ½ of A's and B's together, how much did B and C each receive?

62. John divided a part of his marbles among his three brothers. To the first he gave ⅐ of the whole number, to the second 2 times as many — 4, to the third ½ as many as he gave to the first — 2. He then had 27 marbles. How many had he at first?

63. Bought a number of eggs at 1½ cents each, and twice as many at 1¾ cents each. I sold all at the rate of 3 for 7 cents, and gained 80 cents. How many dozen were sold?

64. A cistern has 3 pipes. The first will fill it in 3¾ hr., the second in 4½ hr., while the third will empty it in 1⅘ hr. If the cistern be full, and all the pipes are opened, in what time will it be emptied?

65. A cistern whose capacity is 1500 gal. has 3 pipes. By the first it receives 50 gal. per min. The second and third discharge respectively 22½ gal. and 25 gal. per min. If the cistern be empty, and all the pipes are opened, in how many hours will it be filled?

66 A farmer has a horse, a colt, and a saddle which is worth $15. The colt and saddle are together worth ⅖ as much as the horse, but the horse and saddle are together worth 4 times as much as the colt. Find the value of the horse and the colt.

67. The time past noon — 3⅓ hr. = ⅔ of the time to *midnight.* What is the hour?

68. Lee has \$199 in silver and gold. $\frac{3}{8}$ of the silver + \$6 = $\frac{9}{10}$ of the gold — \$15. How much has he of each?

69. When George and Herbert entered college, Herbert's age was $\frac{6}{7}$ of George's, and 9 years later, on graduating, Herbert's was $\frac{9}{10}$ of George's. How old was each on graduating?

70. Leslie is $\frac{3}{4}$ as old as his sister, or $\frac{3}{5}$ as old as his brother. If the united ages of the brother and sister = 36 years, how old is Leslie?

71. A boy lost 24 marbles at play. He afterward won $\frac{1}{3}$ as many as remained, and then had $\frac{4}{5}$ as many as at first. How many did he win?

72. If a ten-foot pole, held upright, cast a shadow 16 ft. 8 in. long, how long a shadow will be cast at the same time by a tree 52 ft. 6 in. high?

73. How many times $\frac{1}{6}$ of 75 is $3\frac{1}{3}$ times that number of which $\frac{5}{7}$ of 56 is $\frac{8}{9}$?

74. A jeweler has two watches, and a chain that is valued at \$10. The first watch and chain are worth $\frac{5}{7}$ as much as the second watch; the second watch and chain are worth twice as much as the first watch. Find the value of each watch?

75. A man and his wife together consume a quantity of provisions in 14 days. After living together 10 da. the man left, and his wife consumed the remainder in 12 da. How long would the provisions last each of them?

76. The sum of two fractions is $\frac{21}{40}$, and the greater is $2\frac{1}{2}$ times the less. What are the fractions?

77. I lent A $\frac{2}{5}$ of my money, and B $\frac{4}{9}$ of the remainder. If A received \$50 more than B, how much money had I left?

78. A farmer sold $62\frac{1}{2}$ bu. of wheat, which was $\frac{5}{16}$ of his entire crop. Had he sold it all at $87\frac{1}{2}$ ct. a bu., what *would he have realized*?

79. A man having 75 miles to travel, accomplished $\frac{9}{25}$ of it at the rate of $3\frac{3}{5}$ mi. per hr.; $\frac{4}{15}$ of it at the rate of $3\frac{1}{3}$ mi. per hour; and the remainder at the rate of $3\frac{1}{2}$ mi. per hr. In what time was the journey made?

80. On counting their money it was found that Harry had $\frac{7}{8}$ as much as Charles, and that Jessie had $\frac{2}{5}$ as much as both of the others. If Jessie had $30, how much belonged to each of the others?

81. A man owned $\frac{16}{25}$ of a farm. He sold $\frac{5}{8}$ of his share, and had 30 acres remaining. How many acres were there in the entire farm?

82. A man earns $27\frac{1}{2}$ ct. an hr., and his son $16\frac{2}{3}$ ct. How much will both have earned when the boy has earned $10?

83. If the carpet for a square room whose sides are 15 ft. in length cost $$37\frac{1}{2}$, what was the cost per square yard?

84. Bought a number of apples at 3 for a cent, and as many more at 5 for a cent. Sold all at the rate of 4 for a cent, and lost 5 cents. How many had I?

85. In each of three successive years a merchant gained $\frac{1}{4}$ of what he had at the beginning of the year. If his entire gain was $3050, what was his original capital?

86. Mary's age is $\frac{2}{5}$ of her father's, or $\frac{4}{9}$ of her mother's. If the sum of all their ages is 92 years, how old is each?

87. A works $\frac{2}{3}$ as fast as B, and B works $\frac{3}{4}$ as fast as C. If they together can do a piece of work in 12 days, in what time can each do it?

88. A huckster contracted to furnish 100 dozen eggs to a dealer at 15 cents a dozen, but he was to forfeit 10 cents per dozen for all that he failed to deliver. If he received $$11\frac{1}{4}$, how many dozen did he deliver?

89. $\frac{9}{55}$ of the distance a thief ran before he was over-

taken = the distance he was ahead when the officer started in pursuit. If the officer ran one mile before overtaking him, how many rods ahead was the thief when the race began?

90. A has \$280, which is $\frac{7}{18}$ of what B and C have. If B has $\frac{3}{7}$ as much as both of the others, how much has C?

91. If 12 acres be subtracted from $\frac{4}{5}$ of my land, the remainder will be 2 acres more than $\frac{5}{8}$ of the entire farm. How many acres have I?

92. $\frac{2}{3}$ of A's money added to $\frac{3}{4}$ of B's = \$1500. If B has $\frac{8}{9}$ as much as A, how much has each?

93. If 7 men and 5 boys can do a piece of work in 8 da., in what time can 10 men and 10 boys do the same work, if a boy does $\frac{3}{5}$ as much as a man?

94. The age of A is $\frac{3}{5}$ of the age of B. Twice the age of A is $\frac{3}{2}$ of the age of C. If C is 5 yr. younger than B, how old is each?

95. A grocer bought 10 dozen eggs as follows: 1 dozen at 2 for 5 ct., 2 doz. at 3 for 5 ct., 3 doz. at 4 for 5 ct., and the remainder at 6 for 5 ct. He sold all at a gain of 45 cents. What was the average selling price per dozen?

96. Four-fifths of A's money, increased by \$12 = $\frac{8}{9}$ of B's, diminished by \$8. Together they have \$165. How much has each?

97. A and B are 1 mile apart, and travel toward each other. A takes 7 steps while B takes 6, but two of B's = 3 of A's. When they meet, how many rods farther will B have traveled than A?

98. A, B, and C went fishing. B caught 15 fish, B and C together caught $3\frac{1}{2}$ times as many as A; and $\frac{1}{2}$ of A's + B's = C's number. How many did B and C each catch?

99. The length of a rectangular field is 32 rods, and its area is 6 acres. How much did the fence around it cost, at 50 cents a rod?

100. A is $12\frac{1}{2}$ miles ahead of B, and travels $3\frac{3}{4}$ miles per hour, which is $\frac{5}{6}$ of B's rate of traveling. If A rests 1 hr. and 20 min., in what time will B overtake him?

101. What was the cost of $12\frac{1}{2}$ bu. of wheat if $\$1\frac{3}{20}$ was lost by selling $6\frac{3}{4}$ bu. for $4.25?

102. A lady went shopping. She spent at one store $\frac{1}{2}$ of all her money + $\$\frac{1}{2}$, at a second, $\frac{1}{2}$ of the remainder + $\$\frac{1}{2}$, and so on at a third, fourth, and fifth store, when she had but $1 left. How much had she at first?

Section V.

PERCENTAGE.

LESSON I.

PERCENTAGE includes computations in which 100 is considered the unit.

Any percent of a number is that many hundredths of it.

There are four quantities used in percentage: the *base*, the *rate*, the *percentage*, and the *sum*, or the *difference of the base and the percentage.*

The *base* is the number upon which the percentage is calculated.

The *rate* is so many hundredths of the base.

The *percentage* is the product of the base and the rate.

The sign % is frequently used instead of the word *percent.*

1. What part, or fraction, of any number is 5% of it?

Solution: 5% is $\frac{5}{100}$, or $\frac{1}{20}$. *Answer:* $\frac{1}{20}$ of it.

2. What fraction is 4%? 6%? 8%? 10%?
3. What fraction is 12%? 16%? 18%? 20%?
4. What fraction is 25%? 30%? 35%? 40%?
5. What fraction is 44%? 45%? 48%? 50%?

6. What fraction is 52%? 55%? 56%? 60%?

7. What fraction is 70%? 75%? 80%? 88%?

8. What fraction is 90%? 92%? 95%? 96%?

9. What part of any number is $3\frac{1}{3}\%$ of it?

Solution: $3\frac{1}{3}\%$ is $3\frac{1}{3} \div 100 = \frac{10}{300} = \frac{1}{30}$. *Answer:* $\frac{1}{30}$.

10. What part is $4\frac{1}{2}\%$? $5\frac{1}{3}\%$? $6\frac{1}{4}\%$? $6\frac{2}{3}\%$?

11. What part is $7\frac{1}{2}\%$? $8\frac{1}{3}\%$? $9\frac{1}{11}\%$? $11\frac{1}{9}\%$?

12. What part is $12\frac{1}{2}\%$? $13\frac{1}{3}\%$? $14\frac{2}{7}\%$? $16\frac{2}{3}\%$?

13. What part is $18\frac{3}{4}\%$? $26\frac{2}{3}\%$? $28\frac{4}{7}\%$? $33\frac{1}{3}\%$?

14. What part is $37\frac{1}{2}\%$? $41\frac{2}{3}\%$? $43\frac{3}{4}\%$? $56\frac{1}{4}\%$?

15. What part is $62\frac{1}{2}\%$? $66\frac{2}{3}\%$? $77\frac{7}{9}\%$? $83\frac{1}{3}\%$?

16. What part is $87\frac{1}{2}\%$? $93\frac{1}{3}\%$? $93\frac{3}{4}\%$? $96\frac{2}{3}\%$?

LESSON II.

To Find the Percentage.

1. What is 5 percent of 60?

Solution: 5% is $\frac{5}{100}$, or $\frac{1}{20}$. $\frac{1}{20}$ of 60 is 3. *Answer:* 3.

2. What is 8% of 50? 10% of 90? 15% of 120?

3. What is 18% of 150? 20% of 125? 25% of 144?

4. What is 30% of 70? 35% of 80? 40% of 75?

5. What is 48% of 75? 50% of 90? 60% of 85?

6. What is 70% of 70? 75% of 84? 80% of 95?

7. What is $3\frac{1}{3}\%$ of 90?

Solution: $3\frac{1}{3}\%$ is $\frac{3\frac{1}{3}}{100} = \frac{10}{300} = \frac{1}{30}$. $\frac{1}{30}$ of 90 is 3. *Answer:* 3.

8. What is $6\frac{1}{4}\%$ of 48? $6\frac{2}{3}\%$ of 75? $8\frac{1}{3}\%$ of 96?

9. What is $9\frac{1}{11}\%$ of 55? $11\frac{1}{9}\%$ of 63? $12\frac{1}{2}\%$ of 72?

10. What is $14\frac{2}{7}\%$ of 84? $16\frac{2}{3}\%$ of 54? $18\frac{3}{4}\%$ of 80?

11. What is $26\frac{2}{3}\%$ of 150? $31\frac{1}{4}\%$ of 96? $33\frac{1}{3}\%$ of 111?

12. What is $37\frac{1}{2}\%$ of 56? $41\frac{2}{3}\%$ of 84? $43\frac{3}{4}\%$ of *160?*

13. What is $44\frac{4}{9}\%$ of 81? $53\frac{1}{3}\%$ of 120? $56\frac{1}{4}\%$ of 112?

14. What is $62\frac{1}{2}\%$ of 88? $66\frac{2}{3}\%$ of 57? $68\frac{3}{4}\%$ of 144?

15. What is $83\frac{1}{3}\%$ of 108? $85\frac{5}{7}\%$ of 119? $87\frac{1}{2}\%$ of 128?

16. What is $88\frac{8}{9}\%$ of 99? $93\frac{1}{3}\%$ of 120? $93\frac{3}{4}\%$ of 96?

LESSON III.

1. A farmer having raised 48 sheep, sold $62\frac{1}{2}\%$ of them. How many did he sell?

Solution: $62\frac{1}{2}\% = \frac{62\frac{1}{2}}{100}$, or $\frac{5}{8}$. He sold $\frac{5}{8}$ of 48 sheep = 30 sheep.

2. Bought a gun for $50, and sold it at a gain of 20%. What was the gain?

3. Owning 80 acres of land, I sold 25% of it to one man, and 15% to another. How many acres were sold?

4. A trader having $120, gained $16\frac{2}{3}\%$ of it in one speculation, and $12\frac{1}{2}\%$ of it in another. How much money had he then?

5. A farmer raised 96 bushels of wheat. He sold $33\frac{1}{3}\%$ of it at one time, and $37\frac{1}{2}\%$ of it at another. How many bushels remained?

6. Horses cost $75 apiece. At what price per head must they be sold to realize a profit of 32%?

7. A owned 40 acres of land, and B owned 50 acres. Each sold 40% of his land to the other. How many acres had each then?

8. To make $16\frac{2}{3}\%$ profit, what must eggs be sold for that cost 18 cents a dozen?

9. A cask of wine holding 15 gal. lost 5% by leakage. How many quarts were lost?

10. Having $200, I spent 20% of it for a watch, and 12½% of the remainder for a chain. How much was paid for both?

11. Sold a buggy for $35, thereby losing $\frac{2}{9}$ of the cost. For how much should I have sold it to gain 11$\frac{1}{9}$%?

12. A keg of cider holding 12 gal. 2 qt. lost 4% by leakage. How many gallons remained in the cask?

13. A man having $150, spent 16⅔% of it for a stove, and 12% of the remainder for a carpet. How much money had he left?

14. A horse cost $120, and a set of harness $40. 66⅔% of the cost of the horse + 40% of the cost of the harness = ⅗ of the price of a carriage. What did the carriage cost?

15. A merchant having $300, invested 8⅓% of it in coffee at 16⅔ cents a pound. How many pounds did he buy?

16. A drover bought 40 hogs at $4.50 each. 10% of them were stolen. At what price per head must he sell the remainder to sustain no loss?

17. A farmer raised 360 bushels of corn, and sold 55$\frac{5}{9}$% of it at 50 cents a bushel. What did he get for it?

18. Paid $48 for turkeys at 75 cents each. 6¼% having died, at what price must each be sold to realize a clear profit of 25% on the transaction?

19. Paid $18 for a case of six dozen slates, and sold them at a profit of 20%. What was the selling price of each slate?

20. A trader having $480, spent 16⅔% of it for sheep, 37½% of the remainder for cattle, and the balance for horses at $50 each. How many horses did he buy?

21. A man having 75 miles to travel, rode 48% of the distance in 4½ hours. At what rate per hour did he travel?

22. A grain-dealer paid $200 for oats at $33\frac{1}{3}$ cents a bushel, and sold 25% of it at a profit of 20%. What did he receive for what he sold?

23. A drover sold 60 hogs at $6.25 each, and invested $66\frac{2}{3}$% of the money in sheep at $2.50 each. How many sheep did he buy?

24. A speculator began business with $2100. He gained $14\frac{2}{7}$% of it in one trade, and $16\frac{2}{3}$% of the amount in another. But in a third he lost 25% of his entire capital. How much money had he then?

25. A owns $62\frac{1}{2}$ acres, B $37\frac{1}{2}$ acres. If each sell 48% of his land to the other, how much more will A have than B?

LESSON IV.

How many percent is $\frac{3}{8}$?
Solution: It is $\frac{3}{8}$ of 100%, or $37\frac{1}{2}$%.

Express the following fractions as percents.

1. $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$.
2. $\frac{1}{11}$, $\frac{1}{12}$, $\frac{1}{15}$, $\frac{1}{16}$, $\frac{1}{18}$, $\frac{1}{20}$, $\frac{1}{24}$, $\frac{1}{25}$, $\frac{1}{30}$.
3. $\frac{2}{3}$, $\frac{2}{5}$, $\frac{2}{7}$, $\frac{2}{9}$, $\frac{2}{11}$, $\frac{2}{15}$, $\frac{2}{25}$, $\frac{2}{35}$, $\frac{2}{45}$.
4. $\frac{3}{4}$, $\frac{3}{5}$, $\frac{3}{8}$, $\frac{3}{20}$, $\frac{3}{25}$, $\frac{3}{40}$, $\frac{3}{50}$, $\frac{3}{70}$, $\frac{3}{80}$.
5. $\frac{4}{5}$, $\frac{4}{7}$, $\frac{4}{9}$, $\frac{4}{15}$, $\frac{4}{25}$, $\frac{4}{75}$, $\frac{5}{6}$, $\frac{5}{8}$, $\frac{5}{9}$, $\frac{5}{12}$.
6. $\frac{5}{16}$, $\frac{5}{24}$, $\frac{5}{32}$, $\frac{7}{8}$, $\frac{7}{10}$, $\frac{7}{12}$, $\frac{7}{15}$, $\frac{7}{16}$, $\frac{7}{20}$, $\frac{7}{25}$.
7. $\frac{7}{30}$, $\frac{7}{40}$, $\frac{7}{50}$, $\frac{7}{60}$, $\frac{8}{9}$, $\frac{8}{15}$, $\frac{8}{25}$, $\frac{8}{35}$, $\frac{8}{45}$, $\frac{8}{75}$.
8. $\frac{9}{10}$, $\frac{9}{11}$, $\frac{9}{16}$, $\frac{9}{20}$, $\frac{9}{25}$, $\frac{9}{40}$, $\frac{9}{50}$, $\frac{11}{12}$, $\frac{11}{15}$, $\frac{11}{16}$.
9. $\frac{12}{25}$, $\frac{13}{20}$, $\frac{17}{30}$, $\frac{19}{50}$, $\frac{16}{45}$, $\frac{16}{75}$, $\frac{18}{25}$, $\frac{19}{20}$, $\frac{19}{40}$, $\frac{19}{60}$.
10. $\frac{25}{30}$, $\frac{12}{40}$, $\frac{30}{48}$, $\frac{21}{35}$, $\frac{27}{60}$, $\frac{18}{75}$, $\frac{36}{64}$, $\frac{21}{36}$, $\frac{24}{45}$, $\frac{35}{80}$.

LESSON V.

1. What percent of 40 is 5?

Solution: 5 is $\frac{5}{40}$, or $\frac{1}{8}$, of 40. $\frac{1}{8}$ of 100 percent is $12\frac{1}{2}$ percent.

2. What percent of 10 is 2? of 15 is 9? of 20 is 6?

3. What percent of 24 is 4? 6? 8? 10? 12? 15?

4. $9 are what percent of $30? of $40? of $45? of $50?

5. 12 pounds are what percent of 18 lb.? of 40 lb.? of 75 lb.?

6. What percent are 6 men of 16 men? are 22 yd. of 40 yd.?

7. What percent are 4 gal. of 48 gal.? are 5 bu. of 80 bu.?

8. A boy having 25 marbles lost 4. What percent was lost?

9. Owning 60 acres of land, I sold 21 acres. What % was sold?

10. A earns $75 a month, and B earns $60. What % of A's income is B's?

11. C owed D $80, and paid $\frac{5}{8}$ of it. What % remained unpaid?

12. Out of a flock of 50 pigeons, 16 were killed. What % escaped?

13. A miller keeps 6 qt. out of every 3 bu. that he grinds. What % is his toll?

14. Bought a watch for $30, and sold it for $$37\frac{1}{2}$. What % was gained?

15. Bought a watch for $$37\frac{1}{2}$, and sold it for $30. What % was lost?

16. Sold a gun for $31.50, thereby losing $4.50. What % would have been gained by selling it for $42?

17. If I sell ¾ of an article for ⅘ of its cost, what is the gain percent?

18. If I sell ⅚ of a farm for ⅘ of its cost, what is the loss percent?

19. Bought 18 barrels of flour for $90, and sold 15 barrels for what all cost. What percent was gained?

20. A cask of wine holding 15 gal. lost 3 qt. by leakage. Find the loss %?

21. Bought a cow for $25, and sold her for $27.50. What % was gained?

22. Bought cloth at 5 yd. for $4, and sold it at 4 yd. for $3. What % was lost?

23. A man having $96, spent 16⅔% of it for a coat, and 10% of the remainder for a pair of boots. What % of his money was unexpended?

24. Bought wheat at 3 bu. for $4, and sold it at 2 bu. for $3. What % was gained?

25. By selling oranges at 5 cents each, I cleared ¼ of the cost. What percent would I have cleared by selling them at 2 for 11 cents?

26. A grocer sold coffee at 14 cents a pound, thereby losing ⅛ of the cost. What percent would he have lost by selling it at 3 lb. for 40 ct.?

27. Bought lemons at 4 for 5 cents, and sold them at 5 for 4 ct. What % was lost?

28. Bought apples at 3 for 5 cents, and sold them at 5 for 11 ct. What % was gained?

29. Having 15 gal. of cider, I sold 5 qt. What % of it did I sell?

30. Bought peaches at 7 for 10 ct., and sold them at 5 for 6 ct. What % was lost?

31. Bought cloth at 8 yd. for $5, and sold it at 4 yd. for $3. What % was gained?

32. Bought oranges at 3 for 5 ct., and sold them at 5 *for 6 ct. What* % was lost?

33. By selling coffee at 33 cents a pound, a grocer cleared $\frac{1}{10}$ of the cost. What % would he have cleared by selling it at 37½ ct. a pound?

34. Bought pears at 7 for 10 ct., and sold them at 3 for 5 ct. What % was gained?

35. Bought silk at 4 yd. for $5, and sold it at 5 yd. for $6. What % was lost?

36. Sold a buggy for $105, gaining $15. What % was gained?

37. Sold a horse for $68, losing $12. What % was lost?

38. Paid $3.20 a bushel for strawberries, and sold them at 12½ ct. a quart. What was the gain percent?

39. Bought 50 cords of wood for $225, and sold 30% of it for $90. What % was gained on the part sold?

40. $\frac{4}{11}$ of 44 is what percent of ⅖ of 62½?

41. A farmer bought 40 sheep at $4 a head; 4 having been killed, he sold the remainder at $5 a head. What % did he gain on the whole transaction?

42. If a quart of water be added to 2¼ gallons of wine, what % of the mixture will be water?

43. Paid $3 for eggs, at 16⅔ ct. a dozen, and sold 66⅔% of them for $2.40. What percent was gained on the part sold?

44. Paid $120 for 25 barrels of flour, and sold 40% of it for $60. What % did I gain on what I sold?

45. A gentleman owning 90 acres of land, gave 55$\frac{5}{9}$% of it to his son, and the remainder to his daughter. What % of the son's share did the daughter receive? What % of the daughter's share did the son receive?

LESSON VI.

1. 4 is 2 percent of what number?

Solution: 2 percent $= \frac{1}{50}$. If 4 is $\frac{1}{50}$ of the number, $\frac{50}{50}$ are 50 times 4, or 200. *Answer:* 200.

2. 12 is 2% of what number? 3%? 4%? 6%? 10%?

3. 20 is 8% of what number? 10%? 16%? 25%? 40%?

4. $2\frac{1}{2}$ is 5% of what number? $6\frac{1}{4}$%? $8\frac{1}{3}$%? $62\frac{1}{2}$%?

5. $6\frac{3}{4}$ is 9% of what number? 15%? $37\frac{1}{2}$%? $56\frac{1}{4}$%?

6. $12 are 16% of what? 20%? 24%? 30%? $66\frac{2}{3}$%?

7. A grocer sold 6 sacks of flour, which was 12% of his stock. How many sacks had he at first?

8. A farmer planted 10 acres in corn, which was $12\frac{1}{2}$% of his land. How many acres did he own?

9. I gave $12 for a saddle, which was 15% of what I paid for a horse. What did the horse cost?

10. A merchant sold 18 barrels of apples, which were 45% of his entire stock. How many barrels had he?

11. A farmer sold 180 bushels of potatoes, which was 24% of his entire crop. How many bushels did he raise?

12. Sold a watch at a loss of $16\frac{2}{3}$%, thereby losing $12.50. What did I pay for it?

13. I pay $18 a month for board, which is 36% of my salary. What is my yearly salary?

14. A man bought a wagon for $75, which was $37\frac{1}{2}$% of all his money. How much had he?

15. A's age is 15 years, which is $62\frac{1}{2}$% of B's, or 60% of C's. How old are B and C?

16. Paid $.75 for hauling 60 bushels of coal, which was $8\frac{1}{3}$% of the cost. What was the cost per bushel?

17. A farmer sold 210 bushels of corn, which was $87\frac{1}{2}\%$ of his crop. What was the remainder worth, at 50 ct. a bushel?

18. Sold a gun at a gain of 28%, thereby gaining $7. What did I receive for it?

19. Sold a cow at a loss of 15%, thereby losing $6. What was the selling price?

20. A hunter killed 15 quails, which were 30% of the flock. How many escaped?

21. 20 men out of a regiment were killed in a skirmish. If this was $2\frac{1}{2}\%$ of the entire number, how many men remained?

22. I spent $7.50, which was $12\frac{1}{2}\%$ of what I had remaining. How much had I at first?

23. 15 of my sheep died, which was 20% of what I had left. If I paid $3 apiece for them, what did the entire flock cost?

24. Sold a horse for $50, which was $83\frac{1}{3}\%$ of what I paid for him. What percent would I have gained by selling him for $75?

25. Sold 10 acres of land, which was 25% of what I had left. What percent of the entire tract was sold?

LESSON VII.

1. 18 is 20% more than what number?

Solution: $20\% = \frac{1}{5}$. $\frac{5}{5} + \frac{1}{5}$ are $\frac{6}{5}$ of the number, which $= 18$. Then $\frac{1}{5} = 3$, and $\frac{5}{5} = 15$. *Answer:* 15.

2. 18 is 10% less than what number?

Solution: $10\% = \frac{1}{10}$. $\frac{10}{10} - \frac{1}{10}$ are $\frac{9}{10}$ of the number, which $= 18$. Then $\frac{1}{10} = 2$, and $\frac{10}{10} = 20$. *Answer:* 20.

3. 39 is 30% more than what number? $8\frac{1}{3}\%$?

4. 66 is 12% less than what number? $33\frac{1}{3}\%$?

5. What number added to $12\frac{1}{2}\%$ of itself will $= 99$?

6. What number diminished by 15% of itself will = 51?

7. What number + 28% of itself will = 96?

8. What number — 37½% of itself will equal 90?

9. Sold a sleigh for $54, which was 8% more than its value. What was its value?

10. Paid $32 for a cow, which was 36% less than her value. What was she worth?

11. Sold a team for $210, which was at a loss of 16%. What did I pay for it?

12. A carriage was sold for $110, which was 12% less than it cost. What was the cost?

13. Sold goods at a sacrifice of 24%, receiving only $380 for them. Find the cost.

14. A owns 68 acres of land, which is 15% less than B owns. How many acres do both own?

15. A speculator gained 28% of his capital in a trade, and then had $640. How much did he gain?

16. Sold a stock of dry goods for $520, thereby losing 35%. How much did I lose?

17. Sold a watch for $56, thereby gaining 12%. What percent would I have gained by selling it for $60?

18. Sold 12 oranges for 60 ct., and gained 25%. What did each cost?

19. By selling a horse for $84, there was a loss of 12½%. What percent would have been gained by selling him for $112?

20. Sold two horses for $105 each, gaining 16⅔% on one, losing 16⅔% on the other. Find my loss on the transaction?

21. A sold B a gun for $50, and gained 25%. B then sold it, and lost 30% on what it cost him. How much more did B lose than A gained?

22. Bought a watch for $45, which was 12½% more than its value. I sold it for 5% less than its value. Find my loss.

23. By selling a horse for $55, there was a loss of $8\frac{1}{3}\%$. What % would have been gained by selling him for $75?

24. Sold two lots for $110 each, gaining $37\frac{1}{2}\%$ on one, losing $37\frac{1}{2}\%$ on the other. What was my loss on the sales?

25. By selling cloth at $1.25 a yard, I lost $16\frac{2}{3}\%$. At what price per yard should I have sold it to gain $16\frac{2}{3}\%$?

26. Bought a buggy for $42, which was 16% less than its value. I sold it for 20% more than its value. Find my gain.

27. Sold two horses at $90 each, gaining 25% on one, losing $16\frac{2}{3}\%$ on the other. What was the gain or loss by the sale?

28. Sold a carriage for $75, thereby losing $37\frac{1}{2}\%$. For how much should I have sold it to gain 25%?

29. A sold B a watch for $90, and gained $12\frac{1}{2}\%$. B then sold it and lost 10% on what it cost him. How much more did A gain than B lost?

30. Bought some furniture for $35, which was $16\frac{2}{3}\%$ more than its value. I sold it for 15% less than its value. Find my loss.

LESSON VIII.

1. By selling citrons at 14 cents each, James cleared $\frac{1}{6}$ of the cost. What percent would he have cleared by selling them at 15 ct. each?

2. Sold 8 oranges for 60 cents, and gained 25%. What did each cost?

3. Sold a cow for $30, and lost $16\frac{2}{3}\%$. What % would have been gained by selling her for $48?

4. A keg of wine holding 12 gal. lost 9 quarts by leakage. What was the loss percent?

5. A gardener sold melons at 14 cents each, and lost $\frac{1}{8}$ of the cost. What percent would he have lost by selling 3 for 40 cents?

6. Sold two watches for $55 each, gaining 10% on one, losing $8\frac{1}{3}$% on the other. What was the gain or loss on the transaction?

7. A sold B a buggy for $100, and gained 25%. B then sold it and lost 25% on what it cost him. How much more did B lose than A gained?

8. By selling 4 apples for 7 cents I lost $12\frac{1}{2}$%. What % would I have gained by selling 3 for 7 cents?

9. Sold 15 yards of cloth for $48, and gained $6\frac{2}{3}$%. What was the cost per yard?

10. Sold 16 yards of cloth for $44, and lost $8\frac{1}{3}$%. What percent would I have gained by selling it at $3.75 a yard?

11. Bought a watch for $51, which was 15% less than its value. I sold it for 10% more than its value. Find my gain.

12. Bought a gun for $49, which was $16\frac{2}{3}$% more than its value. I sold it for $14\frac{2}{7}$% less than its value. Find the loss?

13. Sold 15 apples for 51 cents, thereby losing 15%. What percent would I have gained by selling them at 5 cents each?

14. A merchant bought cloth at 6 yards for $5, and sold it at 8 yd. for $7. What percent did he gain?

15. A sold B a wagon for $45, gaining $12\frac{1}{2}$%. B sold it and lost 10% on what it cost him. How much more did A gain than B lost?

16. Sold a lot of pictures for $135, gaining $15. What % was gained?

17. A grocer sold 10 barrels of apples for $30, and lost $6\frac{1}{4}\%$. At what price per barrel should he have sold them to gain $12\frac{1}{2}\%$?

18. Sold my house for $1150, which was at a loss of 8%. What was the loss?

19. A merchant reduced the price of cloth 8 cents per yard, and thereby decreased his profit from $12\frac{1}{2}\%$ to 10%. What was the cost per yard?

20. If a trader loses $20 on a horse which he sells for $105, what percent does he lose?

21. If the retail price of goods is 25% more than the cost, and the wholesale price is 12% less than the retail, what % is gained on goods sold at wholesale?

22. A merchant marked goods which cost $1.50 a yard, so that after deducting $12\frac{1}{2}\%$ from the marked price, he could realize a profit of $16\frac{2}{3}\%$. What was the marked price?

23. If goods are marked at 28% above cost, and are sold at $18\frac{3}{4}\%$ less than the marked price, what % will be gained?

24. Sold a lot of hardware at a profit of 15%, thereby gaining $45. At what price should it have been sold to gain $33\frac{1}{3}\%$?

25. Sold two carriages for $210 each, gaining 40% on one, and losing 40% on the other. What was the percent of loss by the transaction?

26. For how much should a package of sugar weighing $8\frac{4}{5}$ lb. be sold to gain $12\frac{1}{2}\%$, when sugar costs 10 cents a pound?

27. Charles bought a lot of eggs at 1 cent apiece, and twice as many at $1\frac{1}{2}$ ct. each. He sold them all at 18 ct. a dozen. What % did he gain?

28. If I buy buttons at 5 cents a dozen, and sell them at 75 ct. a gross, what % will I gain?

29. A nine-acre pasture is 36 rods wide. What percent of the length is the width?

30. 40% of 50% of 60 is 20% more than 50% of 40% of what number?

31. 40% of 50% of 450 is 60% of 75% of what number?

32. $37\frac{1}{2}\%$ of $66\frac{2}{3}\%$ of 240 is what percent of $31\frac{1}{4}\%$ of 400?

33. $12\frac{1}{2}\%$ of 280 is $12\frac{1}{2}\%$ less than $12\frac{1}{2}\%$ of what number?

LESSON IX.

1. If the gain = $\frac{3}{8}$ of the cost, what is the gain percent?

2. If the gain = $\frac{3}{8}$ of the selling price, what is the gain percent?

Solution: The selling price = $\frac{8}{8}$. Then, if the gain is $\frac{3}{8}$, the *cost* is $\frac{8}{8} - \frac{3}{8} = \frac{5}{8}$. $\frac{3}{8} \div \frac{5}{8} = \frac{3}{5}$ of the cost = 60%.

3. If $\frac{2}{3}$ of the gain = $\frac{6}{25}$ of, the cost, what is the gain percent?

4. If $\frac{2}{3}$ of the gain = $\frac{4}{21}$ of the selling price, what is the gain percent?

5. When the selling price is 7 times the gain, what is the gain percent?

6. When the selling price is $3\frac{1}{2}$ times the gain, what is the gain percent?

7. When the selling price is $4\frac{1}{3}$ times the gain, what is the gain percent?

8. When the loss is $\frac{1}{8}$ of the cost, what is the loss percent?

9. When the loss is $\frac{1}{9}$ of the selling price, what is the loss percent?

10. When $\frac{4}{5}$ of the loss = $\frac{12}{35}$ of the selling price, what is the loss percent?

11. When $\frac{2}{3}$ of the loss = $\frac{3}{8}$ of the selling price, what is the loss percent?

12. If the gain = $\frac{3}{11}$ of the selling price, what is the gain percent?

13. If $\frac{3}{4}$ of the gain = $\frac{6}{25}$ of the cost, what is the gain percent?

14. If $\frac{3}{4}$ of the gain = $\frac{3}{29}$ of the selling price, what is the gain percent?

15. If the selling price = 9 times the gain, what is the gain percent?

16. If the selling price = $7\frac{2}{3}$ times the gain, what is the gain percent?

17. If the selling price is $5\frac{2}{3}$ times the loss, what is the loss percent?

18. If the selling price is $5\frac{1}{4}$ times the loss, what is the loss percent?

19. If the cost = $\frac{5}{6}$ of the selling price, what is the gain percent?

20. If the cost = $\frac{10}{13}$ of the selling price, what is the gain percent?

21. If $\frac{3}{5}$ of the gain = $\frac{6}{50}$ of the selling price, for how much should 24 bl. of flour be sold that cost $\$6\frac{2}{3}$ a bl.?

22. If $\frac{9}{10}$ of the gain = $\frac{18}{55}$ of the selling price, for how much should $11\frac{2}{3}$ cords of wood be sold that cost $6 a cord?

23. If $\frac{4}{7}$ of the gain = $\frac{8}{35}$ of the selling price, for how much should $6\frac{3}{4}$ tons of hay be sold that cost $8 a ton?

24. If $\frac{3}{4}$ of the gain = $\frac{6}{25}$ of the selling price, for how much should $6\frac{4}{5}$ yd. of cloth be sold that cost $5 per yd?

25. If $\frac{8}{11}$ of the gain = $\frac{16}{55}$ of the selling price, for how much should $22\frac{1}{2}$ barrels of cider be sold that cost $4 a bl.?

LESSON X.

Commission.

COMMISSION is a sum of money paid to an agent for buying or selling goods, or for transacting other kinds of business.

When an agent *sells* on commission, his commission is a certain percent of the amount of the sale. If he *buys* on commission, his commission is a certain percent of the sum invested. In the latter case, the sum to be invested is found by dividing the amount received by 1 + the rate of commission. The net proceeds is the sum remaining after deducting the commission, and the charges if there be any.

1. An agent sold $1250 worth of goods on a commission of 4%. Find his commission, and the net proceeds.

Solution: 4% of $1250 = $50, or his commission; and the net proceeds are $1250—$50=$1200. *Answer:* $50 commission; $1200 net proceeds.

2. Sold 175 bl. of flour at $4 a bl., on a commission of 5%. What was the commission?

3. A commission merchant sold 1500 bu. of wheat at 80 ct. a bu., and charged 3⅓% commission. How much did the owner receive?

4. Sold a farm for $2500, and the stock for $1500, charging 2½% commission. What amount did the owner realize?

5. An agent sold city property for $5000 on a commission of 4%, and invested the net proceeds in town lots at $200 apiece, without additional charge. How many lots did he buy?

6. The commission for selling $1800 worth of lumber was $90. What percent was charged?

7. An agent's commission for buying $4500 worth of cotton was $150. What percent did he receive?

8. Sold a lot of grain for $2000, and sent the owner $1930. What percent was the commission?

9. Sold 50 head of horses at $60 per head, and sent the owner $2865. What percent was charged?

10. If the commission is $125, and the net proceeds $1875, what is the percent of commission?

11. An agent sold 1000 bu. of corn at 50 ct. a bu., on a commission of 4%, and invested the net proceeds in flour at $4 a bl., without extra charge. How many barrels did he buy?

12. A merchant allowed a man 15% for collecting bills. The commission was $75. How much was collected?

13. An agent sold grain on a commission of 2½%. If his commission was $50, how much did the owner receive?

14. A man received 10% for collecting delinquent taxes. If he returned $10800, how much did he retain?

15. An agent sold a lot of tobacco on a commission of 6¼%. If the owner received $750, what did the agent keep?

16. A sale of real estate returned $3750 as net proceeds, after deducting $50 expenses, and the auctioneer's charge of 5%. What was the amount of the sale?

17. The net proceeds of the sale of a cargo of grain amounted to $2375, after paying $25 charges, and a commission of 4%. What was the value of the grain?

18. Received $520 to invest in wool. After retaining my commission of 4%, how much was paid for the wool?

19. Sent an agent \$840 to purchase wheat, allowing him 5% of the money expended. How many bushels did he buy at 80 cents per bushel?

20. A commission merchant received \$2050 to buy flour at \$5 a barrel, after reserving his commission of 2½%. How many barrels did he buy?

21. A stock-dealer was requested to purchase horses at \$50 a head, after keeping his commission of 8% for making the purchase. If he received \$1350, how many horses did he buy?

22. An agent sold cotton for \$875, on a commission of 4%. He invested the net proceeds in sugar at \$10 a bl., after retaining 5% commission for buying. How many barrels did he buy, and what was his whole commission?

23. Sold a lot of lumber for \$1200, on a commission of 10%. Invested the net proceeds in corn at 50 cents a bushel, after keeping 8% for buying. How many bushels were bought, and what was the entire commission?

LESSON XI.

Trade Discount.

Wholesale dealers frequently allow discounts to their customers. These discounts are termed *percents off.*

List price, *retail price*, and *marked price* are synonymous terms. The *net price* is what is paid for the goods.

20% off signifies that 20%, or ⅕, is to be deducted from the list price. ¼ and 10 off signifies that ¼ is to be taken from the retail price, and 10% of itself from the remainder.

1. The retail price of a lot of dry goods was $400, but the dealer allowed 12½% off. What did the purchaser pay for them?

Solution: 12½% = ⅛. ⅛ of $400 is $50, and he paid $400—$50 = $350. *Answer:* $350.

2. The marked price of a bill of groceries was $500, but the purchaser was allowed ⅕ and 10% off. What was paid for them?

3. The list price of an invoice of hardware was $1200, but the dealer allowed ⅙, 10, and 4% off. What was the cost of the bill?

4. The retail price of a lot of notions was $750, but the buyer received a discount of 20 and 12½%. What did they cost him?

5. The marked price of a lot of furniture was $960, but the manufacturer gave 16⅔, 12½, and 10% off. What did the purchaser pay for it?

6. An invoice of boots and shoes was listed at $1500, but discounts of ⅕, ⅙, and 5% were allowed. What was the cost of the bill?

7. A bill of goods cost $210, the purchaser having been allowed ¼ and 12½% off. What was the retail price?

Solution: $12\frac{1}{2}\% = \frac{1}{8}$. $\frac{8}{8} - \frac{1}{8} = \frac{7}{8}$, which $= \$210$. $\frac{1}{8} = \$30$. $\frac{8}{8} = \$240$. $\frac{4}{4} - \frac{1}{4} = \frac{3}{4}$, which $= \$240$. $\frac{1}{4} = \$80$. $\frac{4}{4} = \$320$. *Answer:* $320.

8. Paid $340 for a lot of carpets, the dealer having allowed me 20 and 15% off. What was the list price?

9. The cost of a quantity of marble was $350, the buyer having been given discounts of 12½ and 16⅔%. What was the marked price?

10. A retail merchant bought a lot of canned fruits, for which he paid $189, the dealer having given discounts of ¼, 12½, and 10%. At what price were the goods listed?

11. The list price of an invoice of books was \$150, but the purchaser was allowed $16\frac{2}{3}$ and 12% off on \$90, and 20 and $8\frac{1}{3}$% off on the balance. What was paid for the books?

12. Paid \$315 for a lot of toys after having received discounts of $\frac{1}{6}$, $\frac{1}{8}$, and 10%. What was the retail price?

13. The net price of a shipment of school-desks was \$270, which was a reduction of $\frac{1}{4}$, 20, and 10%. What was the retail price?

14. The net price of a bill of goods was \$475, after discounts of 20, $16\frac{2}{3}$, and 5% had been deducted. At what price were they marked?

15. The marked price of a consignment of silks was \$1000, but the wholesale dealer allowed $\frac{1}{5}$ and $12\frac{1}{2}$% off on \$400, and $16\frac{2}{3}$ and 10% off on the remainder. How much did the purchaser pay?

16. Sold goods at 20, $12\frac{1}{2}$, and 10% off, and the discounts amounted to \$111. What was the retail price?

17. Sold merchandise at $\frac{1}{6}$, 10, and 4% off, and the discounts amounted to \$168. What was the list price?

18. Bought goods at 25, 20, and $16\frac{2}{3}$% off, and the discounts amounted to \$250. What was paid for the goods?

LESSON XII.

Insurance.

INSURANCE is indemnity for loss or damage by fire or navigation.

The *Policy* is the written agreement between the parties.

The *Premium* is the sum charged for insurance, and is estimated at a certain percent of the amount insured.

1. Find the cost of an insurance policy for $1500, at $1\frac{1}{2}\%$ premium.

2. Insured a house worth $2400 for $\frac{3}{4}$ of its value, at $1\frac{2}{3}\%$. What was the premium?

3. A hotel worth $5000 was insured for $\frac{4}{5}$ of its value, at $1\frac{3}{5}\%$, the policy costing $1. How much was paid for insurance?

4. A house worth $3200 was insured for $\frac{7}{8}$ of its value, at $1\frac{3}{4}\%$, the policy costing $1. What was the total cost?

5. A house is worth $2800, and the furniture $1250. Insured the house for $\frac{6}{7}$ of its value, at $2\frac{1}{2}\%$, and the furniture for $\frac{4}{5}$ of its value, at $1\frac{1}{2}\%$, the policy costing $1.50. What was the entire cost of insurance?

6. A store is valued at $1500, and the stock at $1000. Both were insured for $\frac{4}{5}$ of their value, at a premium of $3\frac{1}{3}\%$ on the store, and $2\frac{1}{2}\%$ on the stock, the policy costing $1.25. What was the total cost?

7. A boat is worth $2700, and its cargo $2000. Insured the boat for $\frac{2}{3}$ of its value, and the cargo for $\frac{3}{4}$ of its value, paying 2% premium on the boat, 1% on the cargo, and $1.50 for the policy. Find entire cost.

8. A factory is valued at $2800, and the machinery at $1200. Insured the factory for $\frac{3}{4}$ of its value, at $\frac{2}{3}\%$, and the machinery for $\frac{5}{6}$ of its value, at $\frac{4}{5}\%$, paying $1.25 for the policy. How much did it cost me?

9. A house worth $2500 was insured for $\frac{4}{5}$ of its value, and the premium was $50. What was the rate of premium?

10. A vessel worth $6000 was insured for $\frac{5}{6}$ of its value, for which $150 premium was charged. What was the percent?

11. The cost of insuring property worth $3200 for $\frac{3}{4}$ of its value was $40. What was the rate of insurance?

12. \$72 was paid for insuring $\frac{5}{8}$ of a mill worth \$6400. What percent was the premium?

13. Insured my residence for $\frac{4}{5}$ of its value, at $1\frac{3}{4}\%$, paying \$49 premium. What is the value of the residence?

14. The cost of insuring $\frac{5}{6}$ of the value of a cargo of cotton, at $3\frac{1}{3}\%$, was \$100. What was the value of the cotton?

15. Insured $\frac{6}{7}$ of the value of a stock of goods, at $\frac{5}{6}\%$ premium, which cost me \$30. What were the goods worth?

16. A merchant insured $\frac{3}{4}$ of the value of his store, at $1\frac{3}{5}\%$, paying \$72 premium, and $\frac{4}{5}$ of the value of the stock, at $\frac{7}{8}\%$, paying \$28 premium. What was the combined value of store and stock?

17. Paid \$63 for insuring a vessel worth \$4000, at $2\frac{1}{4}\%$ premium. What part of the value was insured?

18. The cost of insuring a factory worth \$7500, at $2\frac{1}{2}\%$, was \$125. What fraction of the value was insured?

19. A cotton-mill and stock worth \$20000 were insured for $\frac{9}{10}$ of their value, at $3\frac{1}{3}\%$. If they were destroyed by fire, what would be the actual loss to the company?

20. A vessel valued at \$15000, of which $\frac{1}{4}$ belonged to A, $\frac{1}{3}$ to B, and the remainder to C, was wrecked. What loss will each sustain, it having been insured for $\frac{4}{5}$ of its value?

LESSON XIII.

Stock and Dividends.

A Stock Company is an association of persons for the transaction of business.

The Capital invested is called the Stock. The owners are called Stockholders.

The Stock is divided into equal parts, called *Shares*.

The value of a Share is usually $100, or $50. If no value is given, $100 is understood.

A *Dividend* is money paid to Stockholders, from the profits of the Company.

An *Assessment* is money paid by Stockholders to meet the expenses or the losses of the Company.

1. A man who owns 25 shares of bank stock, receives a dividend of 4%. What is his dividend?

Solution: 25 shares at $100 per share are worth $2500. 4% of $2500 = $100. *Answer:* $100.

2. An insurance company made an assessment of 2½% on account of losses. If Mr. Roberts owned 20 shares, what did he pay?

3. A telegraph company, whose stock is $100000, declares a dividend of 6¼%. What is the amount of dividend?

4. Bought 60 shares ($50 each) of mining stock. If an assessment of 8⅛% be ordered, what will I have to pay?

5. A capitalist owns 250 shares of steamship stock. If the company declare a dividend of 6%, payable in stock, how many shares will he then own?

6. A gas company declared a dividend of 8%, amounting to $16000. What was the capital stock?

7. A turnpike company struck a 7½% dividend, amounting to $6000. What was the capital stock?

8. A steamboat company declared a dividend of $25000, which was 12½% of its capital stock. How many shares were there?

9. The capital stock of a manufacturing company is $125000, and the net earnings $10000. What will be the rate of dividend?

10. A man who owned 50 shares of railroad stock received a dividend of $350. What was the rate of dividend?

11. I paid an assessment of 5%, or $200, on my mining stock. How many shares did I own?

12. Mr. Stoddard received a dividend of 7½%, or $450, on his bank stock. How many shares did he own?

13. What rate of dividend is declared when the owner of 50 shares receives $100 more than the owner of 40 shares?

14. What assessment is made when the owner of 50 shares pays $300 less than the owner of 75 shares?

15. A stock dividend of 10% was declared, after which Mr. A had 132 shares. How many did he own before the dividend was declared?

LESSON XIV.

Stocks and Bonds.

STOCKS is a general name applied to the shares or bonds of a corporation, and to government bonds and public securities.

BONDS are written or printed obligations to pay certain sums of money at or before a specified time.

United States Stocks are bonds of the United States, payable at some future time, with interest at a fixed rate.

The *par value* of stocks is the value written on their face.

The market value of stocks is what they will sell for.

Stocks are *above par*, or at a premium, when they sell for more than their face value; and they are *below par*, or at a *discount*, when they sell for less than their face value.

A *Broker* is an individual who buys or sells stocks, bonds, etc., for others. *Brokerage* is a percentage charged by brokers for transacting business, and is always estimated upon the *par value.*

1. Find the cost of 40 shares of R. R. stock at par, brokerage $\frac{1}{2}$%.

Solution: The face value is 40 times \$100 = \$4000; the brokerage is $\frac{1}{2}$% of \$4000 = \$20. The entire cost is \$4000 + \$20 = \$4020.

2. A speculator bought 75 shares of bank stock at 8% premium. What did he pay for it?

3. Sold 120 shares of canal stock at 5% discount. What did I receive for the stock?

4. Find the cost of 60 shares of insurance stock at 80, brokerage $\frac{1}{4}$%.

5. What would be the cost of 80 shares of mining stock at 125, brokerage $\frac{1}{2}$%?

6. If I buy 100 shares B. & O. R. R. stock at 10% discount, brokerage $\frac{3}{4}$%, what will it cost me?

7. The brokerage on 50 shares of gas stock was \$40. What was the percent?

8. A broker received \$75 for selling 100 shares of R. R. stock. What percent did he charge?

9. The brokerage on 250 shares of C. & O. stock was \$150. What percent was charged?

10. My broker sold 160 shares of insurance stock at par, and remitted me $15920. What % was his brokerage?

11. Bought 75 shares of telegraph stock at 2¼% discount, and sold it at 1¾% premium. Find my gain.

12. Bought 80 shares of street-car stock at 101½, and sold it at 99. Find my loss.

13. Bought 100 shares of steamboat stock at 2¾% below par, and sold it at 1¼% premium? How much did I gain?

14. A speculator sold 120 shares of telephone stock at 96¼, for which he paid 99¾. What was his loss?

15. The brokerage for buying I. & C. stock was $108. If the rate was ⅗%, how many shares were bought?

16. A broker charged $75 for selling R. R. stock. If the rate of brokerage was ⅝%, how many shares were sold?

17. Bought bonds at 2½% discount, and sold them at 1½% premium, thereby gaining $200. What was the par value?

18. Bought bonds at 1¼% premium, and sold them at 1¼% below par, thereby losing $150. What was the face value?

19. Bought 125 shares of bank stock at 99½, and sold it at 103½, brokerage ½% on each transaction. Find my gain.

20. Bought 125 shares of bank stock at 103½, and sold it at 99½, brokerage ½% on each transaction. Find my loss.

21. I own 125 shares of telegraph stock. If a dividend of 8%, payable in stock, be declared, how many shares will I then own?

Section VI.

INTEREST.

LESSON I.

INTEREST is money paid by a borrower to the lender for the use of money borrowed.

The *principal* is the sum borrowed.

The *amount* is the sum of the principal and the interest.

Interest is always computed upon a certain percent of the sum borrowed, and this percent is called the *rate.*

Given the principal, time, and rate, to find the *interest* or *amount.*

1. Find the interest of $400 for 3 years, at 5%.

Solution: The interest of $400 for 1 year, at 1%, is $4; at 5% is $20; and for 3 years is 3 times $20, or $60. *Answer:* $60.

Remark. A decimal point (.) is supposed to be at the right of the units figure of every integer; and as 1 percent of any number is $\frac{1}{100}$ of it, all that is necessary in finding 1 percent of any number is to remove the decimal *point two places to the left.*

Find the interest of

2. $375 for 2 years, at 4%.
3. $625 for 3 years, at 6%.
4. $750 for 4 years, at 8%.
5. $840 for 2 years, at 10%.
6. $300 for 3 years, at 5%.
7. $500 for 4 years, at 7%.
8. $600 for 5 years, at 9%.
9. $450 for 2 years, at 6⅔%.
10. $800 for 3 years, at 7½%.
11. $900 for 4 years, at 8⅓%.
12. $1200 for 5 years, at 6¼%.
13. Find the interest of $480 for 3 yr. 8 mo., at 5%.

Solution: The interest of $480 for 1 yr. at 1% is $4.80; at 5% is $24; and for 3⅔ yr. is 3⅔ times $24 = $88. *Answer:* $88.

Find the interest of

14. $400 for 2 yr. 1 mo., at 3%.
15. $300 for 3 yr. 2 mo., at 4%.
16. $500 for 1 yr. 3 mo., at 5%.
17. $600 for 2 yr. 4 mo., at 6%.
18. $400 for 3 yr. 6 mo., at 7%.
19. $750 for 4 yr. 7 mo., at 8%.
20. $800 for 3 yr. 11 mo., at 9%.

Find the amount of

21. $250 for 3 years, at 4%.
22. $300 for 4 years, at 5%.
23. $450 for 2 years, at 6%.
24. $600 for 3 years, at 7%.
25. $625 for 4 years, at 8%.
26. $750 for 2 yr. 3 mo., at 4%.
27. $840 for 3 yr. 4 mo., at 5%.

28. $900 for 4 yr. 6 mo., at 6%.
29. $1000 for 2 yr. 9 mo., at 8%.
30. $1200 for 3 yr. 7 mo., at 9%.

LESSON II.

Find the interest of

	PRIN.	TIME.			RATE.		PRIN.	TIME.			RATE.
		yr.	mo.	da.				yr.	mo.	da.	
1.	$120	2	5	24	8%	17.	$ 400	3	7	9	9%
2.	$500	3	6	18	6%	18.	$ 360	2	9	21	5%
3.	$240	1	9	12	5%	19.	$ 450	1	10	10	6%
4.	$800	3	4	21	3%	20.	$ 800	2	5	15	4½%
5.	$750	2	7	6	8%	21.	$ 500	1	3	18	6%
6.	$480	2	1	12	10%	22.	$ 480	2	4	12	5%
7.	$600	3	3	15	6%	23.	$ 240	1	10	6	7%
8.	$540	2	2	12	5%	24.	$ 900	2	8	24	8%
9.	$720	1	9	20	5%	25.	$ 750	1	6	12	6%
10.	$300	3	8	24	8%	26.	$ 300	3	7	24	8%
11.	$840	1	11	15	10%	27.	$ 600	2	5	10	6%
12.	$360	2	2	12	4%	28.	$ 360	2	3	15	3⅓%
13.	$750	1	8	18	8%	29.	$ 540	1	8	20	5%
14.	$900	3	3	21	4%	30.	$ 375	3	7	6	6⅔%
15.	$960	1	7	27	5%	31.	$1000	2	4	27	6%
16.	$450	2	6	24	6%						

Lesson III.

Given the principal, interest, and rate, to find the *time*.

In what time, at 4%, will $250 produce $15 interest?

Solution: The interest of $250 for 1 year at 1% is $2.50; at 4% is $10. The time will be as many years as $10 is contained times in $15, which is 1½ years, or 1 yr. 6 mo. *Answer:* 1 yr. 6 mo.

Find the time in the following

	PRIN.	INT.	RATE.		PRIN.	INT.	RATE.
1.	$200	$ 18	4 %	14.	$ 950	$ 95	4 %
2.	$720	$ 75	5 %	15.	$1000	$108	4½%
3.	$400	$ 35	5 %	16.	$1200	$175	6¼%
4.	$450	$ 36	6 %	17.	$ 840	$ 49	5 %
5.	$500	$ 65	6½%	18.	$ 350	$ 56	6 %
6.	$550	$ 55	8 %	19.	$ 175	$ 49	8 %
7.	$600	$ 70	7 %	20.	$ 150	$150	6⅔%
8.	$650	$ 91	6 %	21.	$ 300	$ 20.25	4½%
9.	$700	$ 63	4 %	22.	$ 600	$216	10 %
10.	$750	$100	6 %	23.	$ 400	$ 99	7½%
11.	$800	$ 96	5 %	24.	$ 500	$ 95	8 %
12.	$850	$ 85	8 %	25.	$1000	$320	9 %
13.	$900	$ 80	3⅓%				

26. In what time at 4% will any principal yield the same amount of interest as in 2 years at 6%?

27. In what time at 6% will any principal yield the same amount of interest as in 4 years at 5%?

28. In what time at 8% will any principal produce as much interest as in 3 years at 7%?

29. In what time will any principal double itself at 4%? 5%? 6%? 6⅔%? 8%? 8⅓%? 9%? 10%?

30. In what time will any principal treble itself at 4%? 5%? 6%? 8%? 10%?

LESSON IV.

Given the principal, interest, and time, to find the *rate*.

1. At what rate percent will $200 produce $68 interest in 4 yr. 3 mo.?

Solution: The interest of $200 for 1 year at 1% is $2. For 4¼ yr., $8½. The rate will be as many percent as $8½ are contained times in $68, or 8%. *Answer:* 8%.

Find the rate in the following:

	PRIN.	TIME.		INT.		PRIN.	TIME.		INT.
		yr.	mo.				yr.	mo.	
2.	$150	3	4	$30	**13.**	$ 650	2	6	$ 97.50
3.	$250	2	6	$25	**14.**	$ 700	3	3	$ 91
4.	$300	3	4	$75	**15.**	$ 750	2	8	$110
5.	$360	1	6	$27	**16.**	$ 800	2	3	$ 90
6.	$375	2	8	$45	**17.**	$ 900	2	1	$ 75
7.	$400	2	3	$54	**18.**	$ 950	2	6	$ 95
8.	$450	3	6	$63	**19.**	$1000	3	6	$210
9.	$475	2	0	$76	**20.**	$1200	3	4	$130
10.	$500	3	9	$75	**21.**	$1250	2	6	$250
11.	$550	2	0	$77	**22.**	$1500	1	8	$150
12.	$600	2	4	$98	**23.**	$ 600	3	9	$ 90

24. $750 2 yr. 4 mo. 24 da. $144.

25. $800 1 yr. 4 mo. 15 da. $88.

26. $400 2 yr. 7 mo. 15 da. $42.

27. $1000 3 yr. 3 mo. 18 da. $110.

28. At what rate % will any principal double itself in 10 yr.? 12 yr.? 15 yr.? 16 yr.?

29. At what rate will any principal treble itself in 20 yr.? 25 yr.? 40 yr.?

LESSON V.

Given the interest, time, and rate, to find the *principal.*

1. The interest of a certain principal for 1 yr. 8 mo., at 6%, was $50. What was the principal?

Solution: In $1\frac{2}{3}$ yr., at 6%, $\frac{10}{100}$, or $\frac{1}{10}$, of the principal = the interest. If $50 is $\frac{1}{10}$, $\frac{10}{10}$ are 10 times $50, or $500. *Answer:* $500.

Find the principal in the following:

	INT.	TIME.		RATE.		INT.	TIME.		RATE.
		yr.	mo.				yr.	mo.	
2.	$ 39	3	3	4%	**13.**	$ 72	3	4	9%
3.	$ 80	2	8	6%	**14.**	$112	3	6	8%
4.	$ 42	1	4	9%	**15.**	$105	3	9	4%
5.	$ 56	1	9	8%	**16.**	$115	3	10	6%
6.	$ 77	1	10	6%	**17.**	$102	4	3	4%
7.	$ 85	2	1	12%	**18.**	$ 57	4	9	8%
8.	$ 72	2	3	8%	**19.**	$ 96	5	4	3%
9.	$ 45	2	6	10%	**20.**	$105	5	3	4%
10.	$ 99	2	9	4%	**21.**	$150	6	8	9%
11.	$102	2	10	12%	**22.**	$800	8	4	6%
12.	$ 95	3	2	6%					

23. $180 for 3 yr. 9 mo. 18 da., at 5%.
24. $ 90 for 1 yr. 10 mo. 15 da., at 8%.
25. $100 for 2 yr. 2 mo. 20 da., at 9%.
26. $360 for 3 yr. 7 mo. 6 da., at 10%.

LESSON VI.

Given the amount, time, and rate, to find the *principal and interest.*

1. The amount of a certain principal for 2 yr. 6 mo., at 6%, was $460. What were the principal and the interest?

Solution: In $2\frac{1}{2}$ yr., at 6%, $\frac{15}{100}$, or $\frac{3}{20}$, of the principal = the interest. Then $\frac{20}{20}+\frac{3}{20}=\frac{23}{20}$ of the principal, which = $460. $\frac{1}{20}=$ $20, and $\frac{20}{20}=$ $400; and the interest is $460—$400 = $60. *Answer:* $400 and $60.

Find the principal and the interest in the following:

	AMT.	TIME.		RATE.		AMT.	TIME.		RATE.
		yr.	mo.				yr.	mo.	
2.	$560	1	6	8%	13.	$630	6	8	6%
3.	$285	1	9	8%	14.	$840	2	6	8%
4.	$484	2	4	9%	15.	$295	4	6	4%
5.	$880	2	6	4%	16.	$490	3	4	12%
6.	$171	2	0	7%	17.	$720	5	6	8%
7.	$690	2	6	6%	18.	$460	1	6	10%
8.	$650	3	4	9%	19.	$880	3	4	3%
9.	$810	3	6	10%	20.	$ 87	2	8	6%
10.	$580	3	9	12%	21.	$ 96	3	6	8%
11.	$350	4	2	6%	22.	$375	2	6	10%
12.	$520	7	6	4%					

23. $ 990 for 3 yr. 6 mo. 20 da., at 9%.
24. $ 750 for 3 yr. 1 mo. 15 da., at 8%.
25. $ 840 for 2 yr. 4 mo. 24 da., at 5%.
26. $1280 for 2 yr. 9 mo. 18 da., at 10%.

Review.

Lesson VII.

1. Find the amount of $120 for 2 yr. 5 mo. 18 da., at 5%.

2. In what time at 8% will $250 produce $75 interest?

3. The interest of $1000 for 3 yr. 6 mo. is $210. What is the rate?

4. The interest for 2 yr. 8 mo. at 9% is $96. What is the principal?

5. The amount of a sum of money for 2 yr. 8 mo. at 7½% was $540. What was the principal?

6. Find the amount of $720 for 2 yr. 7 mo. 21 da., at 6%.

7. In what time at 7% will $600 produce $70 interest?

8. The interest of $750 for 2 yr. 8 mo. was $90. What was the rate?

9. The interest of a sum of money for 3 yr. 6 mo. at 8% was $84. What was the principal?

10. The amount for 3 yr. 4 mo. at 9% was $780. What was the principal?

11. What is the amount of $480 for 1 yr. 5 mo. 18 da., at 5%?

12. The interest of $400 for a certain time at 8% was $92. What was the time?

13. Loaned $600 for 1 yr. 9 mo., and on settlement received $652.50. What was the rate?

14. The interest for 3 yr. 4 mo. at 4½% was $90. Find the principal.

15. The amount for 2 yr. 4 mo. 24 da. at 5% was $840. Find the interest.

16. Find the interest of $1320 for 2 yr. 8 mo. 18 da., at 5%?

17. The amount of $350 for a certain time at 8% was $427. Find the time.

18. The amount of $450 for 2 yr. 4 mo. was $513. What was the rate?

19. The interest for 3 yr. 4 mo. at 7½% was $375. What was the principal?

20. The amount for 2 yr. 8 mo. at 6% was $870. What was the interest?

21. What is the amount of $450 for 3 yr. 5 mo. 18 da., at 8%?

22. Loaned $1000 for a certain time at 5%, and received $180 interest. How long was it loaned?

23. Loaned $750 for 3 yr. 4 mo., and received $850 on settlement. How long was it loaned?

24. The amount of $450 for 3 yr. 8 mo. was $549. What was the rate?

25. The interest of a sum of money for 1 yr. 9 mo. 18 da. at 3⅓% was $27. What was the principal?

26. The amount for 1 yr. 2 mo. 24 da. at 6⅔% was $810. What was the interest?

27. Find the amount of $750 for 2 yr. 4 mo. 18 da. at 6%.

28. The amount of $1250 at 4% was $1380. How long was it loaned?

29. The amount of $1000 for 3 yr. 7 mo. 6 da. at 10% was $1360. What was the rate?

30. What principal will produce $110 interest in 2 yr. 5 mo. 10 da. at 4½%?

31. The amount for 2 yr. 4 mo. 24 da. at 7½% was $295. Find the principal.

32. The amount of a certain principal for a certain time at 4½% is $575, and at 6% is $600. What are the *principal* and the time?

33. The amount of a certain principal for 4 yr. at a certain rate is $480, and for 2 yr. 6 mo. at the same rate is $450. What are the principal and the rate?

34. A note for $420, due in 3 yr. 9 mo., and bearing interest at 4%, was sold for its face 2 yr. 6 mo. before due. What % was the discount?

LESSON VIII.

1. If the interest for 9 mo. is $\frac{1}{12}$ of the principal, what will be the interest of $540 for 1 year 3 mo.?

Solution: $\frac{1}{12}$ of $540 = $45. If $45 is the interest for 9 mo., it will be $\frac{1}{9}$ of $45, or $5, for 1 mo., and 15 × $5, or $75, for 15 mo. *Answer:* $75.

2. If the interest for 1 yr. 8 mo. is $\frac{2}{25}$ of the principal, what will be the interest of $750 for 1 yr. 11 mo.?

3. If the interest for 10 mo. is $\frac{1}{11}$ of the principal, what will be the interest of $880 for 1 yr. 3 mo.?

4. If the interest for 10 mo. is $\frac{1}{20}$ of the principal, what will be the interest of $400 for 1 yr. 7 mo. 18 da.?

5. If the interest for 6 mo. is $\frac{1}{25}$ of the principal, what will be the interest of $750 for 1 yr. 9 mo. 24 da.?

6. If the interest for 1 yr. 4 mo. is $\frac{4}{35}$ of the principal, what will be the interest of $700 for 2 yr. 5 mo. 15 da.?

7. If the interest for 15 mo. is $\frac{3}{28}$ of the principal, what will be the interest of $840 for 1 yr. 10 mo. 24 da.?

8. If the interest for 4 yr. 6 mo. is $\frac{9}{25}$ of the principal, what will be the interest of $300 for 2 yr. 4 mo. 12 da.?

9. If the interest for 1 yr. 10 mo. is $\frac{11}{60}$ of the principal, what will be the interest of $480 for 2 yr. 5 mo. 15 da.?

10. If the amount for 5 mo. is $\frac{26}{25}$ of the principal, what will be the amount of $625 for 1 yr. 7 mo. 21 da.?

Solution: $\frac{26}{25} - \frac{25}{25} = \frac{1}{25}$ of the principal. $\frac{1}{25}$ of the principal = $25. If $25 is the interest for 5 mo., it will be $5 for 1 mo., and for $19\frac{7}{10}$ mo., it will be $19\frac{7}{10} \times \$5 =$ $98.50. Then $625 + $98.50 = $723.50. *Answer:* $723.50.

11. If the amount for 1 yr. 3 mo. is $\frac{31}{28}$ of the principal, what will be the amount of $1120 for 1 yr. 5 mo. 27 da.?

12. If the interest for 3 yr. 9 mo. is $\frac{3}{10}$ of the principal, what will be the amount of $450 for 2 yr. 4 mo. 15 da.?

13. If the interest for 18 mo. is $\frac{3}{85}$ of the principal, what will be the interest of $1050 for 3 yr. 3 mo. 3 da.?

14. If the interest for 1 yr. 8 mo. = $\frac{1}{10}$ of the principal, what will be the interest of $1000 for 3 yr. 4 mo. 15 da.?

LESSON IX.

1. The interest of A's and B's money for 2 yr. 8 mo. at 6% is $96, and A's is 3 times B's. How much has each?

2. The interest of A's and B's money for 1 yr. 8 mo. at 9% is $60, and A's is $\frac{3}{5}$ of B's. How much has each?

3. Twice A's money is 3 times B's, and the interest for $1\frac{3}{5}$ years at 5% of what they both have is $72. How much has each?

4. One half of A's money = $\frac{2}{3}$ of B's, and the interest for 3 yr. 4 mo. at 6% of what they both have is $140. How much has each?

5. $\frac{2}{3}$ of A's money = $\frac{4}{5}$ of B's, and the interest for 2 yr. 9 mo. of what they both have is $121. How much has each?

6. The interest of A's and B's money for $2\frac{2}{5}$ years at 10% is $144, and A's is $1\frac{1}{2}$ times B's. How much has each?

7. $\frac{3}{4}$ of A's money = $\frac{6}{7}$ of B's, and the interest at 6%

for 1 yr. 8 mo. of what they both have is $120. How much has each?

8. The interest of A's and B's money for 1 yr. 9 mo. at 8% is $84, and A's is $2\frac{3}{4}$ times B's. How much has each?

9. The interest of A's and B's money for $3\frac{8}{4}$ yr. at 8% is $180, and A's is 3 times B's. What sum has each?

10. A's money is to B's as 7 is to 3, and the interest for 3 yr. 6 mo. at 6% of what they both have is $105. How much has each?

11. The interest of A's and B's money for 2 yr. 9 mo. at 4% is $66, and A's is to B's as 3 is to 5. How much money has each?

12. A has $\frac{3}{4}$ as much money as B, and the interest for 3 yr. 9 mo. at 8% of what they both have is $315. How much has each?

13. $\frac{3}{4}$ of A's money $=\frac{6}{7}$ of B's, and the interest for 3 yr. 9 mo. at 4% of what they both have is $180. How much money has each?

14. The interest of A's and B's money for 2 yr. 8 mo. at 6% is $480, and A's money is $2\frac{1}{8}$ times B's. How much has each?

DISCOUNT.

LESSON I.

DISCOUNT is an allowance made for the payment of money before it becomes due.

The *present worth* of a debt payable at a future time, *without interest*, is the sum of money which, at a given rate, will amount to the debt when it becomes due.

True discount is the difference between a debt and its present worth, and is the interest on the present worth from the time the debt is paid until it becomes due.

The present worth corresponds to the *principal*, the discount to the *interest*, and the debt to the *amount*.

1. Find the present worth and the true discount of a debt of $480, due in 3 years and 4 months without interest, money being worth 6%.

Solution: In $3\frac{1}{3}$ years at 6%, $\frac{20}{100}$, or $\frac{1}{5}$, of the principal equals the interest; $\frac{5}{5}+\frac{1}{5}$ are $\frac{6}{5}$ of the principal, which = $480. Then $\frac{1}{5}=$ $80, and $\frac{5}{5}=$ $400; and $480 — $400 = $80, which is the discount.

Find the present worth and the true discount of

2. $560, due in 4 yr., money worth 3%.
3. $270, due in 2 yr., money worth 4%.
4. $460, due in 3 yr., money worth 5%.
5. $390, due in 5 yr., money worth 6%.
6. $580, due in 2 yr., money worth 8%.
7. $630, due in 4 yr., money worth 10%.
8. $605, due in 3 yr. 4 mo., money worth 3%.
9. $690, due in 3 yr. 9 mo., money worth 4%.
10. $870, due in 2 yr. 8 mo., money worth 6%.
11. $640, due in 3 yr. 6 mo., at 8%.
12. $520, due in 3 yr. 4 mo., at 9%.
13. $525, due in 2 yr., 6 mo., at 10%.
14. $440, due in 3 yr., at $3\frac{1}{3}$%.
15. $920, due in 2 yr. 6 mo., at 6%.
16. $625, due in 3 yr. 4 mo., at $7\frac{1}{2}$%.
17. $540, due in 2 yr. 6 mo., at 8%.
18. $495, due in 1 yr. 6 mo., at $6\frac{2}{3}$%.
19. $810, due in 1 yr. 7 mo. 6 da., at 5%.
20. $750, due in 3 yr. 1 mo. 15 da., at 8%.

Section VII.

INVOLUTION AND EVOLUTION.

LESSON I.

INVOLUTION is the process of finding any power of a number.

A *power* of a number is the product obtained by using the number as a factor several times.

The first power is the number itself. If the number be taken twice as a factor, the result is the second power, or *square*. Thus, the square of 5 is $5 \times 5 = 25$. If the number be taken three times as a factor, the result is the third power, or *cube*. Thus, the cube of 5 is $5 \times 5 \times 5 = 125$. The higher powers are termed fourth power, fifth power, etc.

The *exponent* shows how many times the number is to be used as a factor. Thus, $3^2 = 3 \times 3 = 9$. $4^3 = 4 \times 4 = 64$. $5^4 = 5 \times 5 \times 5 \times 5 = 625$.

The following tables should be memorized:

$1^2 = 1.$
$2^2 = 4.$
$3^2 = 9.$
$4^2 = 16.$
$5^2 = 25.$
$6^2 = 36.$
$7^2 = 49.$
$8^2 = 64.$
$9^2 = 81.$
$10^2 = 100.$
$11^2 = 121.$
$12^2 = 144.$
$13^2 = 169.$
$14^2 = 196.$
$15^2 = 225.$
$16^2 = 256.$
$17^2 = 289.$
$18^2 = 324.$
$19^2 = 361.$
$20^2 = 400.$

$1^3 = 1.$
$2^3 = 8.$
$3^3 = 27.$
$4^3 = 64.$
$5^3 = 125.$
$6^3 = 216.$
$7^3 = 343.$
$8^3 = 512.$
$9^3 = 729.$
$10^3 = 1000.$
$11^3 = 1331.$
$12^3 = 1728.$

EVOLUTION, or the extraction of roots, is the process of resolving numbers into equal factors.

A *root* is one of the equal factors. The *square root* is one of *two* equal factors. Thus, the square root of 49 is 7, because $7 \times 7 = 49$. The *cube root* is one of *three* equal factors. Thus, the cube root of 216 is 6, because $6 \times 6 \times 6 = 216$. The higher roots are termed fourth root, fifth root, etc.

The radical sign ($\sqrt{\ }$) placed before a number indicates that some root is to be extracted. An *index* is a small figure placed above the radical sign to show the number of the root. Thus, $\sqrt[3]{64}$ means the third or cube root of $64 = 4$. When no figure is placed above the radical sign the square root is understood. Thus, $\sqrt{81} = 9$.

The extraction of roots is sometimes indicated by a fractional exponent. Thus, $64^{\frac{1}{2}}$ and $64^{\frac{1}{3}}$ mean that the square root and the cube root of 64 are to be extracted.

In solving some of the following problems, it should be noticed that: The square of a number is $\frac{1}{4}$ of the square of twice the number.

The square of a number is $\frac{1}{9}$ of the square of three times the number. Also, the square of $\frac{1}{2}$ of a number $= \frac{1}{4}$ of the square of the number, and the square of $\frac{1}{3}$ of a number $= \frac{1}{9}$ of the square of the number.

1. $\frac{3}{4}$ of the square of a number $= 75$. What is the number?

Solution: If $\frac{3}{4}$ of the square $= 75$, $\frac{1}{4}$ of the square $= 25$, and $\frac{4}{4}$, or the square of the number $= 100$. Then the number is $\sqrt{100} = 10$.

2. $\frac{4}{5}$ of the cube of a number $= 100$. What is the number?

3. The square of $\frac{1}{2}$ of a number is 9. Find the cube of the number.

4. One half of the square of a number is 128. What is the square root of the number?

5. If $\frac{2}{5}$ of a regiment of soldiers be formed in a square, there will be 20 men on a side. How many compose the regiment?

6. A meadow is $12\frac{1}{2}$ rods long, and 8 rods wide. What would be the length of one side of a square meadow of equal area?

7. A field is 16 rods wide and 25 rods long. If it were in the form of a square, how many rods of fence would surround it?

8. A square room requires 25 square yards of carpet. How many feet long is each side?

9. How much more fence would be required for a lot 16 rods long, and 9 rods wide, than for a square lot of equal area?

10. Extract the square root of the cube root of $\frac{64}{729}$.

11. The square root of $\frac{2}{3}$ of the cube of a number is 12. What is the number?

12. If a certain number be multiplied by its square, the product will be 512. What is the number?

13. A number multiplied by its square root $= 343$. What is the number?

14. If a certain number be divided by its cube root, the quotient will be 81. Find the number.

15. $\frac{7}{3}$ of the cube of a number is 1 less than the cube of $\frac{4}{3}$ of the number. What is the number?

16. $\frac{2}{3}$ of the square of a number is 18 more than the square of $\frac{2}{3}$ of the number. Find the number.

17. $\frac{3}{4}$ of the square of twice a number $= \frac{3}{5}$ of the square of $\frac{5}{2}$ of the number, minus 12. What is the number?

18. There is a certain number of sheep in a pasture, and $\frac{4}{3}$ of the number multiplied by $\frac{5}{4}$ of the number are 84 less than the square of $\frac{3}{2}$ of the number. How many sheep are there?

19. A company of men bought a tract of land for \$1000. If the number of men, the number of acres each received, and the number of dollars paid per acre were all equal, what was the price per acre?

20. A square room contains 16 square yards of carpet. If each side were 3 feet longer, how many square yards would be required?

21. A rectangular bar of lead is 18 in. long, 4 in. wide, and 3 in. thick. If it were cast into a cube, what would be the length of one edge?

22. How many two-inch cubes could be placed in a cubical box which is 1 foot deep?

23. How many dice, whose edges are $\frac{1}{2}$ inch in length, could be placed in a box 10 in. long, 5 in. wide, $2\frac{1}{2}$ in. deep (inside measurements)?

24. $\sqrt[4]{256} \times \sqrt[3]{125} \times \sqrt{\frac{1}{400}} =$ what?

25. The cost of polishing five faces of a cubical block of granite, at 1 cent a square inch, was \$7.20. What was the length of one edge?

26. $\frac{5}{9}$ of the square of 3 times a certain number is 50 more than 27 times the square of $\frac{1}{3}$ of the number. Find the number.

27. The carpet for a square room cost \$27, at 75 ct. a sq. yd. Had it been Brussels carpet ($\frac{3}{4}$ yd. wide), at \$1.25 a yard, what would it have cost?

28. A rectangular reservoir is ten times as wide as it is deep, and twice as long as it is wide. If 5400 cubic yards of earth were removed in constructing it, what are its dimensions in feet?

29. A rectangular pasture is twice as long as it is wide, and its area is 5 acres. Find the cost of the fence surrounding it, at 50 cents a rod.

30. A rectangular solid is square at the ends, and its length is 3 times its width. Its contents are 1536 cubic inches. What are its dimensions?

There is an easy and elegant method of squaring numbers less than 100, by using an algebraic theorem: "The square of the *sum* of two numbers is equal to the square of the first, plus twice the product of the first by the second, plus the square of the second."

Square 45 by the theorem $(45 = 40 + 5)$.

$40^2 = 1600$; $40 \times 5 \times 2 = 400$; $5^2 = 25$. Then $1600 + 400 + 25 = 2025$, answer.

The teacher can assign as many problems under this theorem as he chooses. Exercises like the following should occasionally be given orally:

1. Square 6, add 13, extract square root, multiply by 9, add 1, extract cube root, square, square again, subtract 31, extract square root, multiply by 8, add 5, extract cube root. What is the result?

2. Cube 8, subtract 12, multiply by 2, subtract 100, extract square root, multiply by 12, subtract 17, extract cube root, square, add 1, multiply by 2, extract square root. Result?

LESSON II.

Similar figures are those having the same form, as squares, circles, etc.

Similar solids are those having the same shape, but differing in size, as cubes, spheres, etc.

Similar figures are to each other as the squares of their like dimensions; therefore,

The ratio of the areas of two similar figures is equal to the square of the ratio of their like dimensions; and,

The ratio of the like dimensions of two similar figures is equal to the square root of the ratio of their areas.

Similar solids are to each other as the cubes of their like dimensions; therefore, The ratio of two similar solids is equal to the cube of the ratio of their like dimensions; and,

The ratio of the like dimensions of similar solids is equal to the cube root of the ratio of their volumes.

1. There are two rectangular gardens similar in shape. If the first is five rods long, and the second 20 rods, how many times as large as the first is the second?

Solution: The ratio of 20 to 5 is 4, $4^2 = 16$. *Answer:* 16 times as large.

2. How many pipes 2 inches in diameter will discharge as much water as one pipe 6 inches in diameter?

3. The area of a triangular lot whose base is 120 ft., is 900 sq. yd. What is the base of a similar lot whose area is 3600 sq. yd.?

4. A rectangular field is 50 rods long, and 32 rods wide. What are the dimensions of a similar field whose area is 90 acres?

5. A cistern whose capacity is 3200 gal. is filled by a 3-inch pipe in 80 minutes. In what time could a 4-inch pipe fill it?

6. If an iron ball 3 inches in diameter weigh 5 pounds, what would another ball of the same kind of metal weigh, whose diameter is 9 inches?

Solution: The ratio of 9 to $3 = 3$. $3^3 = 27$. 27×5 lb. $= 135$ lb. *Answer:* 135 lb.

7. A log 10 ft. long contains 24 cu. ft. What would be the solid contents of a similar log 20 feet in length?

8. A pile of cracked stone $16\frac{1}{2}$ ft. long, $1\frac{1}{2}$ ft. wide, and 1 ft. high $= 1$ perch. What are the dimensions of a similar pile containing 64 perches?

9. How many marbles $\frac{1}{2}$ inch in diameter would be equal in volume to a marble ball 10 inches in diameter?

10. A pyramid is 5 ft. square at the base, $7\frac{1}{2}$ ft. high, and its solidity is $62\frac{1}{2}$ cubic ft. What are the dimensions of a similar pyramid whose solidity is 500 cubic ft.?

Section VIII.

MISCELLANEOUS QUESTIONS.

1. The contents of a rectangular bin are 240 cubic feet. If its length, breadth, and depth inside have the ratios of 5, 3, and 2 respectively, what are its dimensions?

2. For how much should a package of sugar weighing $7\frac{1}{2}$ lb. be sold to gain 25%, when sugar costs $10\frac{2}{8}$ ct. a lb.?

3. Bought a number of eggs at $1\frac{1}{2}$ ct. each, and twice as many at $1\frac{3}{4}$ ct. each. Sold all at the rate of 3 for 7 ct. What percent did I gain?

4. B has 50 acres of land, which is $66\frac{2}{3}$% of A's. If each sell 48% of his land to the other, which will have the more, and how much more?

5. A lady has two watches, and a chain worth $20. The first watch and the chain are together worth $\frac{5}{6}$ as much as the second watch, but the second watch and the chain are worth $1\frac{3}{4}$ times as much as the first watch. What is the value of each watch?

6. A had $2\frac{1}{2}$ times as much money as B, but after A had borrowed 25 cents, and B had spent 10 cents, A had $3\frac{1}{2}$ times as much as B. How much had each at first?

7. $\frac{5}{6}$ of the square of a number$-9=$ the square of $\frac{5}{6}$ of the same number $+ 11$. What is the number?

8. A drover spent $50 for sheep, and $\frac{3}{5}$ of the remainder of his money for cows, and found that he had $\frac{1}{8}$ of all his money remaining. How much had he at first?

9. The square of the cube root of a common fraction is $\frac{16}{81}$; what is the cube root of the square root of the same fraction?

10. A can mow a field in $8\frac{3}{4}$ da. B can mow $\frac{1}{2}$ of the field in $\frac{2}{3}$ of that time. In what time can both mow it?

11. On counting their money, it was found that B's money was $\frac{5}{4}$ of A's, and that C had $\frac{2}{3}$ as much as both of the others. If C had $5 more than A, how much had B?

12. A and B have equal incomes. A contracts an annual debt equal to $\frac{1}{6}$ of his income, while B lives upon $\frac{4}{5}$ of his, and at the end of 8 yr. lends A enough to pay his debts, and has $320 left. What is the income of each?

13. If $77\frac{1}{2}$ lb. of sea-water contain $2\frac{1}{2}$ lb. of salt, how much salt must be added to make 52 lb. of the mixture contain 2 lb. of salt?

14. 10 men were employed to do a piece of work, but 4 of them not coming, the others were occupied 3 days longer. In what time could 9 men have done the work?

15. What principal will in 3 yr. 4 mo., at $7\frac{1}{2}$%, amount to the same as $500 will in 4 yr., at 5%?

16. Two men travel toward each other, one at the rate of $3\frac{1}{3}$ mi. per hour, the other 40% faster. If the distance was 60 mi., in what time did they meet, and how much farther did one travel than the other?

17. A dealer bought a number of horses for $1500. 6 having been stolen, he sold $\frac{5}{8}$ of the remainder at cost, and received $750. How many did he buy?

18. A man and his son can do a piece of work in 5 hr. If the son rests $2\frac{1}{2}$ hr. it takes them 6 hr. In what time can each do the work?

19. If a man loses $$10\frac{1}{2}$ on a watch that he sells for $$59\frac{1}{2}$, what % does he lose?

20. A boat, whose rate of sailing is 8 mi. per hr., makes a trip down a river whose current is 2 mi. an hr. How far can it go and return in 12 hr.?

21. A bought 6 peaches, B 8, and C 10. They were joined by D, and each ate an equal number. When D left, he gave the others 15 cents. How should they have divided it?

22. $\frac{8}{10}$ of $22\frac{2}{9}$ is $\frac{2}{3}$ of the difference between two numbers, and the less equals $\frac{7}{9}$ of the greater. What are the numbers?

23. The sum of two numbers is 135, and their difference is $\frac{1}{7}$ of the smaller number. What are the numbers?

24. A pier was $\frac{3}{8}$ under water. The water rose 15 ft., and then there was as much of it under water as had been above water. How high was the pier?

25. The amount of a certain principal for 3 yr. 6 mo. at a certain rate % is $484, and for 2 yr. 3 mo. at the same rate is $454. What are the principal and the rate?

26. An express train was to run 320 mi. at the rate of 40 mi. an hour, but after going $\frac{7}{16}$ of the distance, an accident delayed it 45 min. If it completed the trip at the rate of 45 mi. an hour, how much behind time did it arrive?

27. A and B entered into partnership for one year. A at first put in $500, and at the end of 4 mo. $500 more. B at first put in $1000, but at the end of 8 mo. drew out $500. They gained $500. How was it divided?

28. Sold molasses at 45 ct. a gal. and gained $12\frac{1}{2}$%. Had I bought it for 20% less, and sold it at 48 ct. a gal., what % would my profit have been?

29. A farmer plows an acre of ground for every 5 cows that he owns, and allows 1 acre of pasturage for every 3 cows. How many cows can he keep on 24 acres?

30. 20 men charter a pleasure-boat, but being joined by 5 more, the expense to each is 50 ct. less. What do they pay for the boat?

31. B has 3 times as much money as A, but if A had $10 more, and B $20 less, A's money would equal $\frac{1}{2}$ of B's. How much has each?

32. A dairyman bought a number of cows for $750. Had he bought 10 more at $5 apiece less, all would have cost $1000. How many did he buy?

33. A steamer goes down stream at the rate of 10 mi. an hr., and up stream at the rate of 6 mi. an hr. If it takes 4 hr. less to go down than to return, how far did it go down?

34. The wages of 6 men and 4 boys for one week is $90, and of 4 men and 6 boys is $75. How much do one man and one boy earn weekly?

35. A gamester won $750. He then lost $\frac{1}{5}$ of all his money, and found that he had twice as much as at first. What had he at first?

36. The interest of A's money + $\frac{3}{4}$ of the interest of B's, for 3 yr., at 4% = $180. How much has each, if $\frac{1}{2}$ of B's = $\frac{2}{8}$ of A's?

37. $\frac{3}{8}$ of the difference in the contents of two cisterns is $112\frac{1}{2}$ gal., and the contents of the smaller are to those of the larger as $3\frac{1}{2}$ to $4\frac{1}{2}$. How many gallons are in each?

38. If 8 men can mow 100 acres of meadow in 5 da., in what time can 75 acres be mown if $\frac{3}{4}$ of the men leave when the work is $\frac{4}{5}$ completed?

39. The square root of a certain number, divided by the cube root of the same number = 3. What is the number?

40. If 40 lb. of sea-water contain $1\frac{1}{2}$ lb. of salt, how much fresh water must be added to make 10 lb. of the mixture contain $\frac{1}{4}$ lb. of salt?

41. A rectangular piece of marble is 5 in. square

and 4 in. high. What would it cost to polish the entire surface of a cubical block of marble whose solid contents are 10 times as great, at ¼ ct. a square inch?

42. A man has 3 sons, A, B, and C; A is ⅜ older than B, C is ¼ younger than B, and the father's age equals the sum of his sons' ages. If the sum of all their ages is 100 years, how old is each?

43. A cistern can be filled by 2 pipes in 24 min. and 36 min. respectively, and emptied by another in 18 min. If all three are left open, in what time will the cistern be filled?

44. A merchant increased the price of a lot of hardware $10, and thereby increased his profit from 12½% to 15%. What was the first marked price?

45. What is the side of a square whose area is 6 times as great as that of a triangle whose base is 30 rods, and altitude 40 rods?

46. The amount of a certain principal for a certain time, at 5%, is $690, and at 7% is $726. Find the principal and the time.

47. The sum of two numbers is 65, and the square of their difference is 225. What is the cube root of their product?

48. Mary is 16 years old, and her mother is 40. How many years ago was the mother just 3 times as old as Mary?

49. Sold a team of horses at a loss of 16⅔%. Had they cost $100 less, I should have gained 25%. What was the selling price?

50. A steamer goes 12 mi. an hour with the current, and 8 mi. an hour against it. How far can it go and return in 10 hours?

51. C's money is $10 more than ⅖ of D's, and $20 less than 7/10 of D's. How much money has each?

52. Alfred is $\frac{3}{8}$ as old as his father, or $\frac{5}{12}$ as old as his mother, and his sister's age is $\frac{3}{5}$ of his. If the sum of all their ages is 100 years, how old is each?

53. An officer pursued a thief. The officer ran 5 steps while the thief ran 6, but 3 of the thief's steps = only 2 of the officer's. If the officer ran 300 yards before overtaking him, how far was the thief ahead when the race began?

54. If, in the above question, the officer had taken 300 *steps* before arresting him, how many of his own steps would the thief have had the start? How many more would he have made when overtaken?

55. B has twice as much money as A + $4, and the interest for one yr. 7 mo. 15 da., at 8%, of what they both have is $16.90. How much has each?

56. A cistern has 3 pipes. The first can fill it in $2\frac{1}{2}$ hr.; the second can fill $\frac{3}{10}$ of it in an hour. If all the pipes are open, the cistern will be filled in 40 min. In what time can the third pipe fill it?

57. The sum of the ages of B and C = $3\frac{1}{3}$ times A's age; C is $\frac{4}{9}$ as old as A and B together. If A is 15 years old, what are the ages of B and C?

58. A cattle-dealer received $1260 to invest in an equal number of horses at $50, mules at $40, and cows at $30 each, after retaining his commission at 5% for buying. How many of each did he purchase?

59. A and B agree to do a piece of work for $75. A works two days more than B, and receives $40. How many days does each work?

60. The fence around a square lot cost $40, at 50 ct. a rod. What would it cost to fence another square lot 9 times as large, at $66\frac{2}{3}$ ct. a rod?

61. A merchant imported brandy at $3.60 a gallon. 4% was lost by leakage. At what price per gallon must he sell the remainder to gain $33\frac{1}{3}$% on the cost of all?

62. A note for $625, due in 4 yr., and bearing interest at 5%, was sold for its face 3 yr. 4 mo. before it was due. What percent was the discount?

63. Twenty men are employed to build a bridge in 6 da. At the end of half the time, half of the men leave. How many additional men must be employed at the beginning of the sixth day to complete the work on that day?

64. The product of three numbers is 36000. One of them is 40; the other two are equal. What is the sum of the numbers?

65. Three men bought a farm of 216 acres, which they divided in the ratios of $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{7}{12}$ respectively. What was the share of each?

66. A builds $\frac{2}{5}$ of a wall in $2\frac{1}{2}$ da.; B then assists him, and they complete it in $1\frac{1}{2}$ da. more. In what time can each build it?

67. If 3 cats can kill 3 rats in 3 min., in how many min. can 9 cats kill 15 rats?

68. Bought a lot of goods at $33\frac{1}{3}$, $16\frac{2}{3}$, and 10% off, and sold them for $\frac{3}{4}$ of the list price. What % did I gain?

69. A has $$37\frac{1}{2}$, and B $$87\frac{1}{2}$. How much should B lend A, that A may then have $\frac{2}{3}$ as much as B?

70. John has $120 in silver and gold, and for every $5 in gold he has $3 in silver. How much gold must he spend that he may then have $5 in silver for $3 in gold?

71. What is the greatest number that will divide 307, 223, and 125, and leave the same remainder in each case?

72. Bought horses at $60 each. 10% having died, at what price per head must the remainder be sold to gain $12\frac{1}{2}$% on the entire cost?

73. Four boys start from the same place at the same time, and walk in the same direction around a race track 600 rd. in circumference, at the rate of 8, 10, 12, and 15 rd. per min. respectively. In what time will all first arrive at the starting place?

74. What is the difference between the interest and the true discount of $1000 for 3 yr. 1 mo. 15 da., at 8%?

75. A can do a piece of work in 6 da. B a piece twice as large in 15 da. C a piece 3 times as large in 20 da. In what time by working together can all do a piece $4\frac{1}{2}$ times as large as the first?

76. I have two horses and a saddle. The first horse is worth $45. The first horse and saddle are together worth $\frac{1}{2}$ as much as the second horse, but the second horse and saddle are worth 3 times as much as the first horse. Find the value of the second horse and the saddle?

77. Clifford is 21 years old, and his father is 47. In how many years will Clifford be just half as old as his father?

78. Sold a piano at a gain of 20%. Had it cost $250 more, I should have lost 20%. What did I receive for it?

79. A rectangular piece of granite is square at the ends, and its length is $2\frac{1}{2}$ times its width. If its solid contents are 2500 cubic inches, what would be the cost of polishing its entire surface at 1 ct. a sq. in.?

80. A man agreed to work a year for $360 and a cow. At the end of 9 mo. he received $260 and the cow. What was the cow worth?

81. In an alloy of silver and copper weighing 30 lb., there are 2 lb. of copper. How much silver should be added that there may be $\frac{5}{8}$ lb. of copper to 10 lb. of silver?

82. Eleven years ago, D was 3 times as old as his son, but one year hence he will be only twice as old. What are their ages at present?

83. A owned 100 acres of land, which was $37\frac{1}{2}$% less

than B owned. B sold $62\frac{1}{2}\%$ of his land to A, who in turn sold $37\frac{1}{2}\%$ of what he then owned to B. Who then had the more, and how much more?

84. A house, lot, and stable cost such a sum of money, that if the interest upon it for 1 year at 10% were placed upon interest for 4 yr. 9 mo. 18 da. at 5%, it would *amount* to $620. If the lot cost $1\frac{1}{2}$ times as much as the stable, and the house $1\frac{2}{3}$ times as much as the lot, what did each cost?

85. A speculator bought 3 farms containing respectively 126, 153, and 171 A., which he divided into lots of the largest possible size to contain an equal number of acres. If he sold the lots at $500 apiece, what did he realize?

86. A can do a piece of work in $\frac{5}{9}$ wk., and B in $\frac{5}{6}$ wk. After B has worked alone for $\frac{5}{12}$ wk., in what time can both complete the work?

87. A gentleman drove to town at the rate of $7\frac{1}{2}$ mi. an hour, and returned at the rate of 6 mi. an hour. His business occupied him 30 min., and he was absent from home 8 hr. How far from the city did he live?

88. A trader bought a number of sheep for $48. Had he bought 3 times as many + 1, at the same rate, they would have cost him $100 more. How many did he buy?

89. A telegraph pole is 36 ft. long, and the part in the ground + 2 ft. equals $\frac{1}{4}$ of the part in the air + $\frac{1}{2}$ ft. How long is each part?

90. A, B, and C, aged respectively 19, 15, and 13 years, inherited $5800, which was so divided that their several shares at 10% simple interest, should amount to equal sums when they arrive at the age of 21 years. What was the share of each?

91. A rectangular lot is 8 rods wide, and its area is

$\frac{5}{8}$ of an acre. Another lot is square, and its area is $2\frac{1}{2}$ acres. If the second lot were similar in shape to the first, how many more rd. of fence would it require than it already has?

92. A can do a piece of work in 12 days. $\frac{4}{5}$ of what A does equals $\frac{2}{3}$ of what B does, or $\frac{8}{15}$ of what C does. After all three had been working 3 days, A left, and B and C finished it. How long did it take them?

93. A, B, and C went hunting. B killed 20 birds; B and C together killed twice as many as A, and $\frac{5}{8}$ of A's + B's = $2\frac{1}{2}$ times C's. How many did A and C each kill?

94. A speculator sold two horses at the same price, gaining 20% on one, and losing 20% on the other. If he lost $10 by the transaction, what was the cost of each horse?

95. The entire surface of a cube is 1 sq. ft. 6 sq. in. How long is the edge of another cube whose volume is 27 times as great?

96. A man, dying, left $10000 to be divided among his widow, son, and daughter, on condition that if the daughter died, the widow should have $\frac{3}{8}$ of the money; but if the son died, the widow should have $\frac{3}{5}$ of it. Both son and daughter survived. What did each of the heirs receive?

97. A and B can do a piece of work in 10 da., A and C in 12 da., B and C in 15 da. In what time can all do it, working together? In what time can each do it?

98. A steamer sailed 45 miles and back in 16 hr. If it went 5 miles down the stream in the same time that it went 3 miles up, find its time in going and returning, and also its rate per hr. each way, and the rate of the current.

99. A rectangular piece of granite is square at the ends, and its length is twice its width. If the entire area

of its surface is 640 sq. inches, what is its value at 5 mills a cubic inch?

100. The interest of a sum of money for 2 yr. 4 mo. 24 da., at 5%, was \$84. What would have been the true discount of the same sum, for the same time, at the same rate?

101. In a farm of 160 acres, $\frac{4}{5}$ of the meadow-land — 8 acres $= \frac{12}{25}$ of the woodland $+$ 24 acres. How many acres of each are there?

102. The time past noon $+ \frac{5}{7}$ of the time from then until midnight $= \frac{2}{3}$ of the time past midnight. What is the hour?

103. An agent sold a consignment of flour at \$5 a bl. on a commission of 2%. He then invested the net proceeds in wheat at \$1.40 a bu., after keeping a commission of 5% for buying. His entire commission was \$100. How many bl. of flour did he sell, and how much wheat did he buy?

"DUBBS' ARITHMETICAL PROBLEMS."

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A THOROUGH knowledge of Arithmetic can not be acquired unless the student has had sufficient drill in its manifold departments to fix their principles firmly in his memory. Rapidity of execution and correctness of result can only be attained by continued practice and close attention to fundamental principles; and even then his efforts can not be completely successful unless he makes himself master of every subject. To accomplish this, he should have such a number of problems under each of the general departments as will almost exhaust them; and when we consider the immense number of combinations that can be proposed in the applications of common and decimal fractions and of percentage, it is evident that a corresponding number of problems should be given to illustrate them properly.

The text-books on Arithmetic now in use in our schools are standard works; but all teachers agree that in one essential respect they are defective—they do not embrace a sufficient number of examples to insure that proficiency which is the principal aim of every instructor. It follows, then, that there must be a demand for a carefully graded collection of problems that will supply this deficiency, and aid the teacher in his important work.

Three years ago it was suggested to the author that he write a book of test examples to supplement the corresponding departments of Ray's New Practical Arithmetic. After having consulted some of the leading educators in Hamilton County, he decided to undertake the work, and the result is a volume of 4500 problems, thoroughly classified, and so arranged as to supplement Ray's New Arithmetic, although it is intended to accompany any other text-book upon the same subject. The manuscript has been submitted to most of the leading educators of this county, and has received their unqualified approval, as the accompanying testimonials will certify.

Some of the advantages claimed for the work are briefly these: 1. A sufficient number of examples has been given in each department as almost to exhaust it. 2. The problems are presented in a very attractive manner, and most of them under entirely new conditions. 3. In reduction of compound numbers, more than half of the examples given under the tables are concrete. 4. In the applications of common and decimal fractions and interest—in fact, throughout the entire work—the answers are, with but few exceptions, exact. 5. Several new features have been introduced, as G. C. D. and L. C. M. of fractions, rules for forming triangles and trapezia, etc. 6. A chapter has been devoted to certain kinds of difficult problems, with suggestions and formulæ for their solution. Finally, the typography and binding are especially attractive, and can not fail to please any teache who desires a handsomely printed and durable book o arithmetical problems.

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Principal Sterling School, Cleveland, O.

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JOHN B. PEASLEE,
Ex-Superintendent Cincinnati Public Schools.

CINCINNATI O., August 8, 1892.

I have carefully examined "Dubbs' Arithmetical Problems," and can speak most favorably of the book for the following reasons:

1st. It is filled with a useful variety of problems of all sorts on every subject of Arithmetic.

2d. The problems are practical.

3d. They are accurately placed before the pupil, and so graded as to be within his comprehension as he advances in the course.

4th. The language is clear, concise, and simple. The entire course of Arithmetic is thoroughly canvassed by this collection of problems, thus giving scope and diversity.

5th. As a supplemental text-book it is invaluable both to teacher and pupil, if the item of time-saving alone be considered.

6th. It is a book long since desired in our schools, and will supply a long-felt want.

I heartily recommend it. Very respectfully,

E. H. PRICHARD,
Principal Third Intermediate School.

CINCINNATI, August 10, 1892.

To Teachers of Arithmetic:

An experience of more than twenty years in teaching the mathematical branches in our public schools has given me opportunities for observing the wants and needs of the teacher in the matter of labor-saving text-books to supplement the ordinary courses of study.

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Such a work is presented to the teachers of Arithmetic in the Test Examples prepared by Mr. Eugene Dubbs, and I take pleasure in saying that I have made a very careful examination of this book, and can recommend it as the best work of this kind that I have ever seen.

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I heartily recommend the work, and hope it may meet with the recognition which it merits and deserves.

J. H. BROMWELL,
Late Professor of Mathematics, Hughes High School.

TESTIMONIALS.

LOCKLAND, O., July 15, 1892.

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Teacher of Mathematics.

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Very respectfully,
JOHN C. HEYWOOD,
Principal Sixteenth District and Intermediate School,
Mt. Auburn.

TESTIMONIALS.

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